MITSUBISHI
Mitsubishi Industrial Robot

RP-1AH/3AH/5AH Series INSTRUCTION MANUAL
ROBOT ARM SETUP & MAINTENANCE

MELFA

BFP-A8111-C

⚠ Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠ CAUTION

All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
→ Enforcement of safety training

⚠ CAUTION

For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
→ Preparation of work plan

⚠WARNING

Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
→ Setting of emergency stop switch

⚠ CAUTION

During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
→ Indication of teaching work in progress

⚠WARNING

Provide a fence or enclosure during operation to prevent contact of the operator and robot.
→ Installation of safety fence

⚠ CAUTION

Establish a set signaling method to the related operators for starting work, and follow this method.
→ Signaling of operation start

⚠ CAUTION

As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
→ Indication of maintenance work in progress

⚠ CAUTION

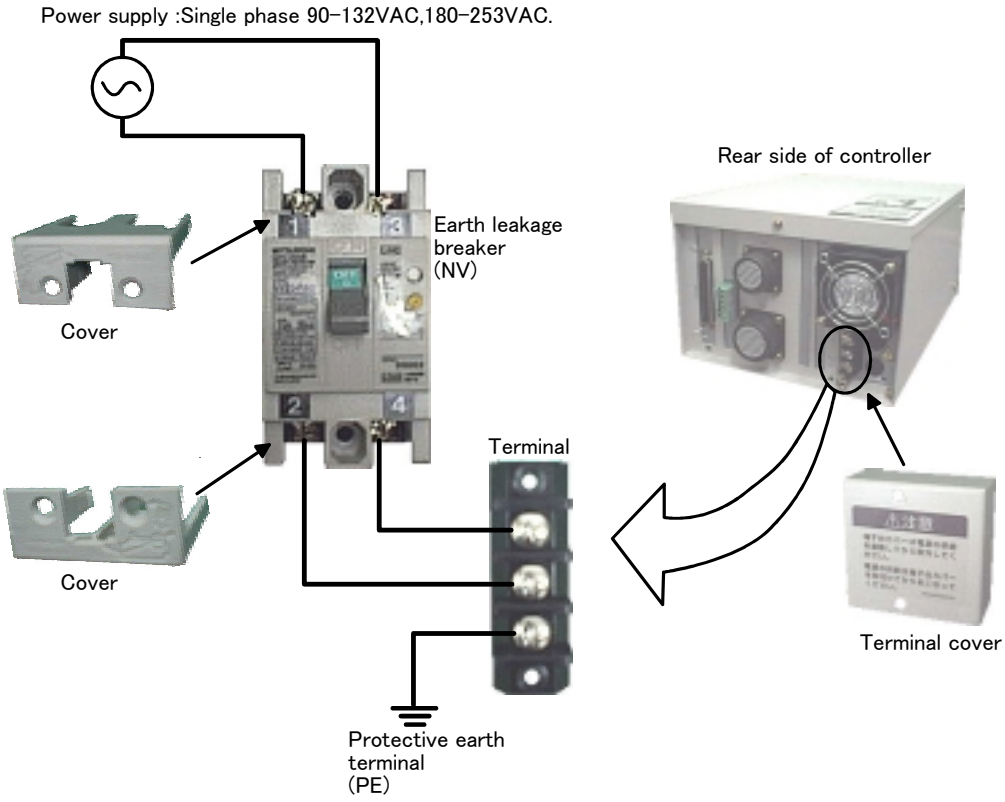
Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
→ Inspection before starting work

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠ CAUTION	Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)
⚠ CAUTION	Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.
⚠ CAUTION	Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.
⚠ CAUTION	Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.
⚠ CAUTION	Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.
⚠ CAUTION	Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.
⚠WARNING	Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.
⚠WARNING	Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.
⚠ CAUTION	Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.
⚠WARNING	When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.
⚠ CAUTION	Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.
⚠ CAUTION	After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.
⚠ CAUTION	Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.
⚠ CAUTION	Never carry out modifications based on personal judgments, or use non-designated maintenance parts. Failure to observe this could lead to faults or failures.
⚠WARNING	When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.
⚠ CAUTION	Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF. If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.

C.Precautions for the basic configuration are shown below.(When CR1-571 is used for the controller.)

⚠ CAUTION Provide an earth leakage breaker that packed together on the primary power supply of the controller as protection against electric leakage.
Failure to do so could lead to electric shock accidents.



Revision history

Date of Point	Instruction Manual No.	Revision Details
2000-05-15	BFP-A8111Z	First print
2000-06-15	BFP-A8111Z-a	Error in writing correction
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2000-09-06	BFP-A8111-B	Notice about grease was added.
2001-03-21	BFP-A8111-C	Error in writing correction.

■ Introduction

Thank you for purchasing the Mitsubishi industrial robot.

This instruction manual explains procedures to be taken for unpacking, installing, servicing and inspecting the robot arm.

Always read through this manual before starting use to ensure correct usage of the robot.

- No part of this manual may be reproduced by any means or in any form, without prior consent from Mitsubishi.
- The details of this manual are subject to change without notice.
- The information contained in this document has been written to be accurate as much as possible. Please interpret that items not described in this document "cannot be performed.".
  Please contact your nearest dealer if you find any doubtful, wrong or skipped point.

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1 Before starting use

This chapter explains the details and usage methods of the instruction manuals, the basic terminology and the safety precautions.

1.1 Using the instruction manuals

1.1.1 The details of each instruction manuals

The contents and purposes of the documents enclosed with this product are shown below. Use these documents according to the application.
For special specifications, a separate instruction manual describing the special section may be enclosed.

Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup to Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller Setup, Basic Operation to Maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Explanation of Functions and Operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.

1.1.2 Symbols used in instruction manual

The symbols and expressions shown in Table 1-1 are used throughout this User's Manual. Learn the meaning of these symbols before reading this instruction manual.

Table 1-1 : Symbols in instruction manual

Symbol	Meaning
⚠DANGER	Precaution indicating cases where there is a risk of operator fatality or serious injury if handling is mistaken. Always observe these precautions to safely use the robot.
⚠WARNING	Precaution indicating cases where the operator could be subject to fatalities or serious injuries if handling is mistaken. Always observe these precautions to safely use the robot.
⚠CAUTION	Precaution indicating cases where operator could be subject to injury or physical damage could occur if handling is mistaken. Always observe these precautions to safely use the robot.
[JOINT]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
[+／ＦＯＲＷＤ] ＋ [＋Ｘ] （Ａ） （Ｂ）	This indicates to press the (B) key while holding down the (A) key. In this example, the [+/Forward] key is pressed while holding down the [+X/+Y] key.
[ＳＴＥＰ／ＭＯＶＥ] ＋([ＣＯＮＤ]→[ＲＰＬ ↓]) （Ａ） （Ｂ） （Ｃ）	This indicates to hold down the (A) key, press and release the (B) key, and then press the (C) key. In this example, the [Step/Move] key is held down, the [Condition] key is pressed and released, and the [Replace ↓ key is pressed.
Ｔ／Ｂ	This indicates the teaching pendant.

1.2 Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠ CAUTION All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
→ Enforcement of safety training

⚠ CAUTION For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
→ Preparation of work plan

⚠ WARNING Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
→ Setting of emergency stop switch

⚠ CAUTION During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
→ Indication of teaching work in progress

⚠ DANGER Provide a fence or enclosure during operation to prevent contact of the operator and robot.
→ Installation of safety fence

⚠ CAUTION Establish a set signaling method to the related operators for starting work, and follow this method.
→ Signaling of operation start

⚠ CAUTION As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
→ Indication of maintenance work in progress

⚠ CAUTION Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
→ Inspection before starting work

1.2.1 Precautions given in the separate Safety Manual

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠ CAUTION Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)

⚠ CAUTION Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.

⚠ CAUTION Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.

⚠ CAUTION Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.

⚠ CAUTION Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.

⚠ CAUTION Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.

⚠ WARNING Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.

⚠ WARNING Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.

⚠ CAUTION Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.

⚠ WARNING When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.

⚠ CAUTION Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.

⚠ CAUTION After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.

⚠ CAUTION Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.

⚠ CAUTION Never carry out modifications based on personal judgments, or use non-designated maintenance parts.
Failure to observe this could lead to faults or failures.

⚠ WARNING When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

⚠ CAUTION Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF.
If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.

2 Unpacking to Installation

2.1 Confirming the product

The standard configuration of the robot arm section, part of the purchased product, is shown in Table 2-1. Confirm the parts.
Users who have purchased optional products should refer to the separate "RP-1AH/3AH/5AH Series Standard Specifications".

Table 2-1 : Standard configuration

No.	Part name	Type	Qty. according to type-identifier			Remarks
			RP-1AH/ 1AHC-SB	RP-3AH/ 3AHC-SB	RP-5AH/ 5AHC-SB	
1	Robot arm	RP-1AH/1AHC-SB, RP-3AH/3AHC-SB, or RP-5AH/5AHC-SB	Either one unit			
2	Guarantee card		1 copy			
3	Installation bolts	M6 x 35	4 pcs.	-		
		M8 x 45	-	4 pcs.		
4	Spring washer for installation bolts	For M6	4 pcs.	-		
		For M8	-	4 pcs.		
5	Insulock tie	SKB-1M	2 pcs.			
6	Arm fixing plates	Transportation jigs A	1 pc.	-		
		Transportation jigs B	2 pcs.			
		Transportation jigs D	-	1 pc.		
7	Arm fixing plate installation bolt	M4 x 12	2 pcs.	-		For fixing transportation jig A
		M3 x 14	2 pcs.			For fixing transportation jig B
		M4 x 14	-	2 pcs.		For fixing transportation jig D

2.2 Installation

2.2.1 Unpacking

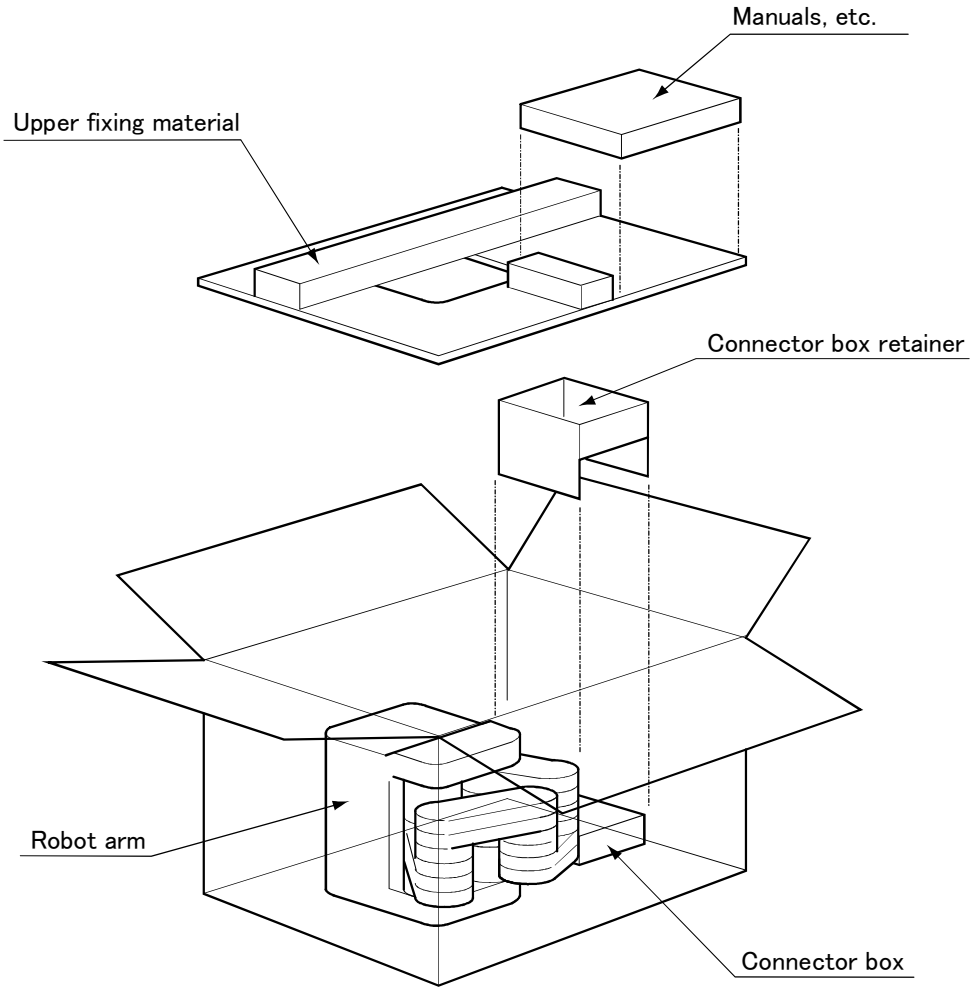


Fig.2-1 : Unpacking the robot arm

The robot is shipped from the factory in cardboard packaging. Refer to Table 2-1 and unpack the robot. Handle the robot arm following "2.2.2Transportation procedures".

2.2.2 Transportation procedures

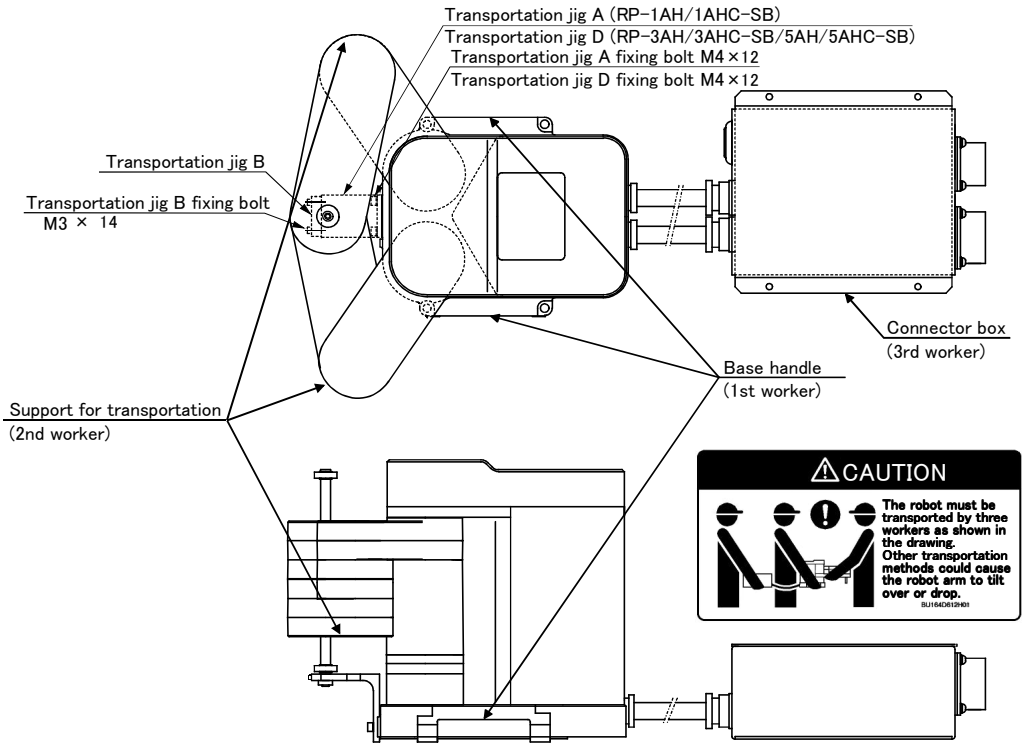

Transportation jig A (RP-1AH/1AHC-SB)
Transportation jig D (RP-3AH/3AHC-SB/5AH/5AHC-SB)
Transportation jig A fixing bolt M4×12
Transportation jig D fixing bolt M4×12
Transportation jig B
Transportation jig B fixing bolt
M3 × 14
Connector box
(3rd worker)
Base handle
(1st worker)
Support for transportation
(2nd worker)
CAUTION
The robot must be transported by three workers as shown in the drawing.
Other transportation methods could cause the robot arm to tilt over or drop.

Fig.2-2 : Transportation posture, transportation method, and fixing positions

1) Open the cardboard box, and remove the cushioning material fixing the robot arm and connector box.
2) When transporting the robot, leave the transportation jigs A and B in place to protect the arm from external force. Three workers must transport the robot for safety purposes.
   As shown in "Fig. 2-2Transportation posture, transportation method, and fixing positions", one worker must hold the handle on the robot arm base, another worker must hold the robot arm, and a third worker must hold the connector box.

⚠ CAUTION To prevent accidents, do not hold the axis section on the end of the robot, or pull the cables.

3) Avoid applying vibration or impact when transferring the robot to the installation place.
4) Remove the transportation jigs A and B after installing at the installation place. Always remove transportation jigs A and B before starting the robot operation.
5) Use the same transportation procedures described above during secondary transportation, such as when changing the installation place. If the arm section is lifted without using the designated transportation jigs, or if the robot is transferred in the work posture, hazards could occur during the transportation work, such as the configuration devices being damaged or the center of gravity position being deviated.

2.2.3 Installation procedures

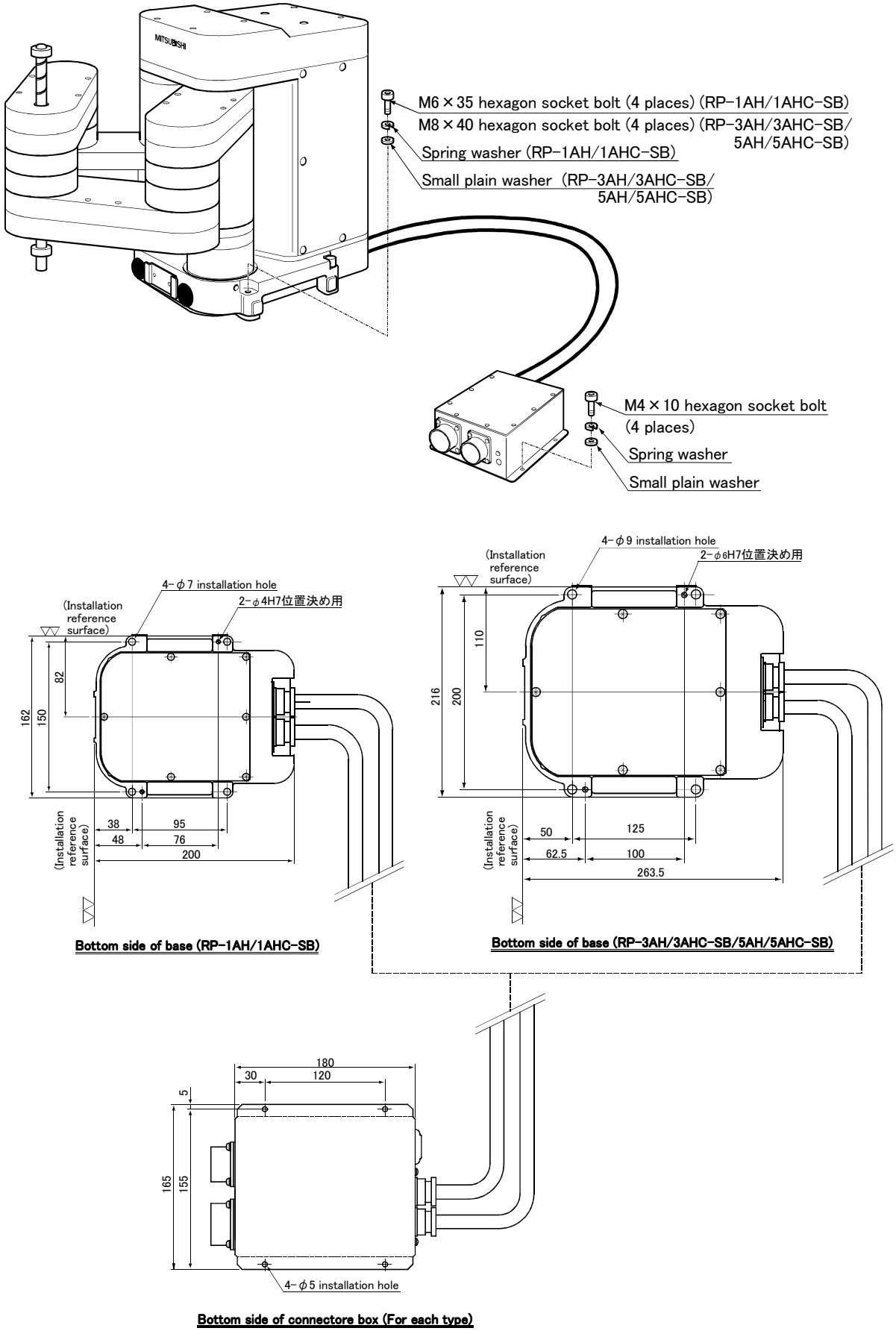


Fig.2-3 : Installation procedures and installation dimensions

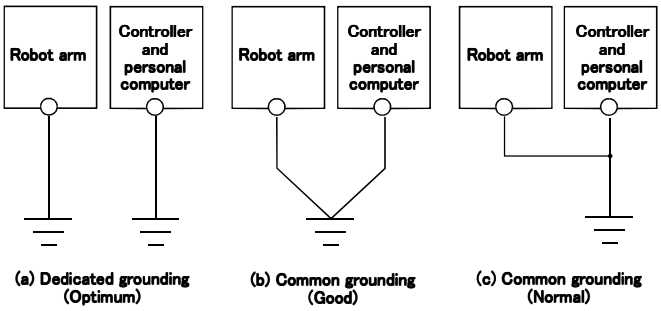
The installation surface of the robot arm has been machined finished, so securely fix the robot arm with the installation holes (RP-1AH/1AHC-SB: 4-ϕ7 hole, RP-3AH/3AHC-SB/5AH/5AHC-SB: 4-ϕ9 hole) provided at the four corners of the base and the enclosed installation bolts (RP-1AH/1AHC-SB: M6 x 35 hexagon socket bolts, RP-3AH/3AHC-SB/5AH/5AHC-SB: M8 x 40 hexagon socket bolts).

Installation of the robot arm is a very important step for ensuring the optimum functions of the robot. Observe the following points when designing.

1) Keep the installation surface flat.
2) The surface roughness of the installation surface should be ▽▽ or more. If the installation surface is rough, the robot seating will be poor, and positional deviation could occur when the robot is operated.
3) It is recommended to use a common table when installing to prevent positional deviation of the devices and jigs targeted for robot work.
4) Make sure that the installation surface has sufficient rigidity to prevent deformation or vibration caused by the arm reaction during operation, and from the static (dynamic) load of the robot arm and peripheral devices.
5) Fix the connector box with M4 hexagon socket bolts. (To be prepared by user. Should have length of 10mm or more.)

2.2.4 Grounding procedures

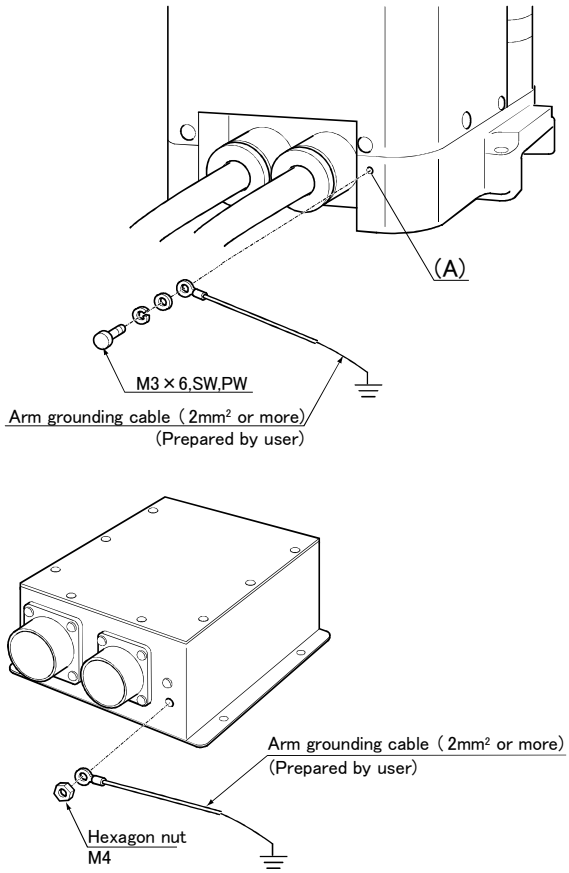
(1) Grounding methods



1) There are three grounding methods as shown in Fig. 2-4 , but the dedicated grounding (Fig. 2-4 (a)) should be used for the robot arm and controller when possible. (Refer to the separate "Controller setup, basic operation, and maintenance" for details on the controller grounding.)
2) Use Class D grounding (grounding resistance 100Ω or less).
Dedicated grounding separated from the other devices should be used.
3) Use a 2mm^2 or more stranded wire for the grounding wire. The grounding point should be as close to the robot arm and controller as possible, and the length of the grounding wire should be short.

Fig.2-4 : Grounding methods

(2) Grounding procedures



1) Prepare the grounding cable (2 mm^{2}or more) and robot side installation screw and washer.

2) If there is rust or paint on the grounding screw section (A), remove it with a file, etc.

3) Connect the grounding cable to the grounding screw section.

Fig.2-5 : Connecting the grounding cable

2.2.5 Connecting with the controller

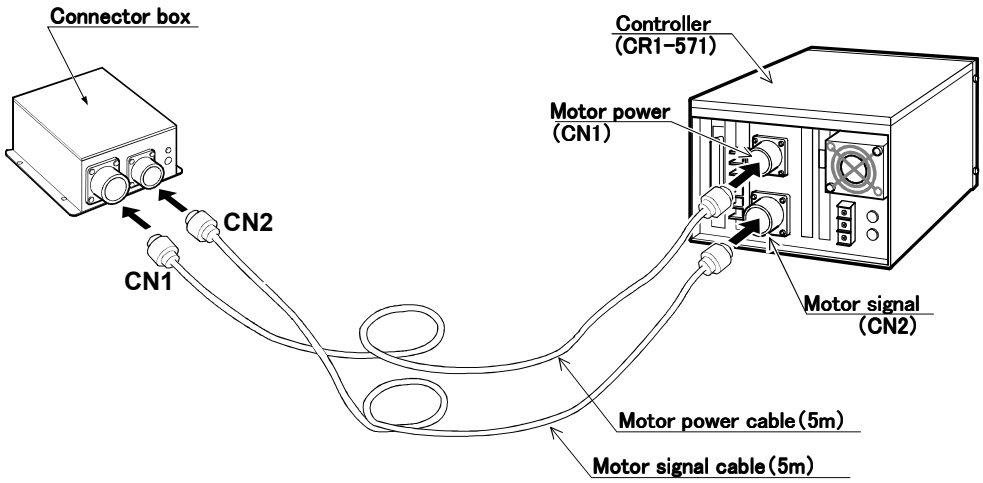


Fig.2-6 : Connecting the machine cables(CR1 controller)

Carry out the following procedure after installing the controller referring to the separate "Controller setup, basic operation, and maintenance" manual.

1) Make sure that the power switch on the front of the controller is turned OFF.
2) Connect the machine cable to the robot arm and the corresponding connector on the controller.

⚠ CAUTION The machine cable connectors are dedicated for the controller side and robot arm side, so take special care when connecting.
If connected incorrectly, the connector pins could bend or break. Thus, even if connected correctly, the robot will not operate correctly, creating a dangerous situation.

⚠ CAUTION Take special care to the leading of the connection cable. If the cable is pulled with force or bent excessively, wires could break or the connector could be damaged.

2.3 Setting the origin

The origin is set so that the robot can be used with a high accuracy. After purchasing the robot, always carry out this step before starting work. This step must also be carried out if the combination of robot and controller being used is changed.

There are several methods for setting the origin, but the origin data input method will be explained here. Refer to page 55, "5.5 Resetting the origin" for the other methods.

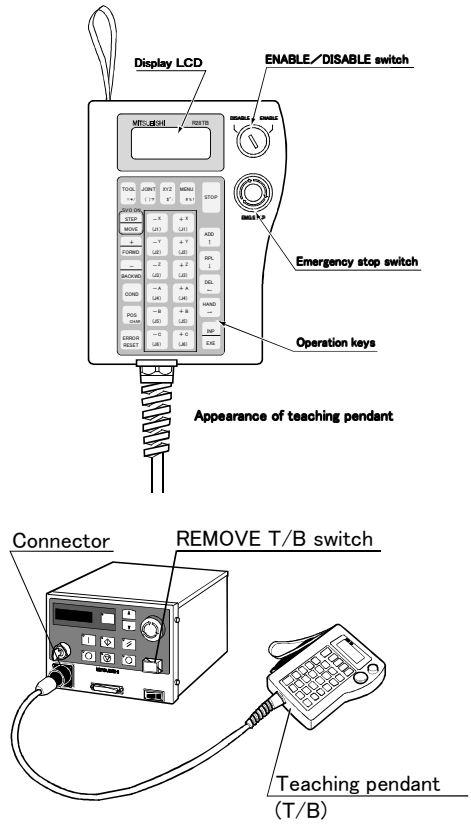
The teaching pendant is required for this operation.

2.3.1 Installing the teaching pendant (T/B)

By using the "REMOVE T/B" switch, the T/B can be installed and removed while the controller's control power is ON. However, in this procedure, the teaching pendant will be installed with the control power OFF.

Refer to the separate "From Controller Setup to Maintenance" for details on installing the teaching pendant with the control power ON.

(1) Installing with the control power OFF



1) Confirm that the controller's power supply switch is OFF.

2) Connect the T/B connector to the RS-422 (T/B) connector on the controller.

3) Fix the connector with the top and bottom screws so that it will not come off.

4) Do not pull the cable with force or bend it excessively, as the cable could break or the connector could be damaged.

5) Confirm that the [REMOVE T/B] switch on the side of the controller is not depressed (is projected).

6) Set the T/B [ENABLE/DISABLE] switch to "DISABLE".

Fig.2-7 : Installing the T/B (control power OFF)

◇◆◇ [REMOVE T/B] switch ◇◆◇

When using the robot with the T/B, this switch is used to invalidate the emergency stop from the T/B. This is also used to install the T/B with turning the controller's power supply ON.

2.3.2 Setting the origin with the origin data input method

(1) Confirming the origin data

● Origin data history table (Origin Data History) Serial No.ES804008

Date	Default	. . .	. . .	. . .
D	V!#S29			
J 1	06DTYY			
J 2	2?HL9X			
J 3	1CP55V			
J 4	T6!M$Y			
J 5				
J 6				
Method	E	E・N・SP	E・N・SP	E・N・SP

(O: AlphabetO, 0: Zero)

Note) Meanings of symbols in method column
E: Jig method
N: Not used
SP: Not used

The origin data to be input is noted in the origin data sheet enclosed with the arm, or on the origin data history table attached to the back side of the connector box cover. (Refer to Fig. 2-8).

Referring to page 51 "Fig. 5-12Replacing the battery", remove the connector box cover, and confirm the value.

The value given in the default setting column is the origin settings set with the calibration jig before shipment.

Fig.2-8 : Origin data label

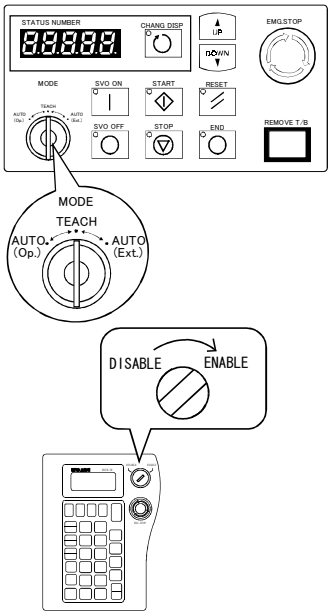
⚠ WARNING Always install/remove the cover with the controller control power turned OFF. Failure to do so could lead to physical damage or personal injury should the robot start moving due to incorrect operations.

(2) Turning ON the control power

⚠ CAUTION Confirm that there are no operators near the robot before turning the power ON.

1) Turn the controller [POWER] switch ON.
The control power will be turned ON, and " □ . 100" will appear on the STATUS NUMBER display on the front of the controller.

(3) Preparing the T/B



Next, prepare to use the T/B.

1) Set the [MODE] switch on the front of the controller to "TEACH".

2) Set the T/B [ENABLE/DISABLE] switch to "ENABLE". The menu selection screen will appear.
The following operations are carried out with the T/B.

◇◆◇ Operating from the T/B ◇◆◇

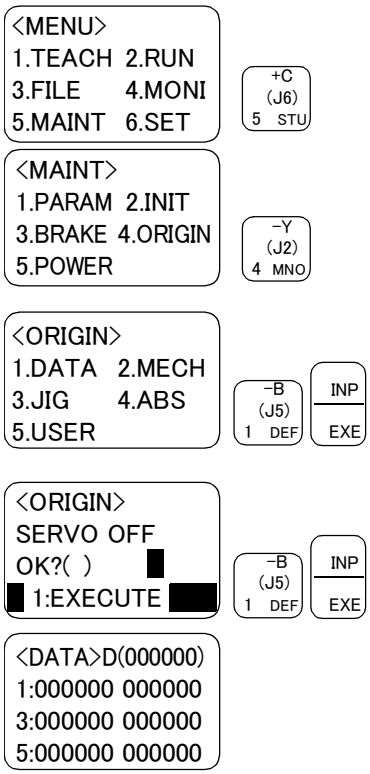
Always set the [MODE] switch (mode selection key switch) on the front of the controller to "TEACH", and then set the T/B [ENABLE/DISABLE] switch to "ENABLE".
When the T/B is valid, only operations from the T/B are possible. Operations from the controller or external signals will not be accepted.

◇◆◇ When T/B operations are mistaken ◇◆◇

The displayed screen will return to the "menu selection screen" when the [MENU] key is pressed. Carry out the operations again from this screen. Operations can also be carried out again by setting the T/B [ENABLE/DISABLE] switch to "DISABLE" once and then setting to "ENABLE".

(4) Selecting the origin setting method

<T/B screen> [Keys used]



1) Press the [5] key on the menu screen, and display the maintenance screen.

2) Press the [4] key on the maintenance screen, and display the origin setting method selection screen.

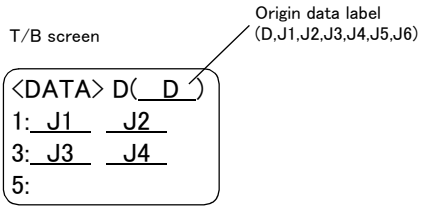
3) Press the [1] key on the origin setting method selection screen, and select the data input method.
The origin data input method will be selected, and the screen for turning OFF the servo power will appear.

4) Press the [1] and [INP] keys to turn OFF the servo power. The screen for inputting the origin data will appear.

◇◆◇ Selecting a menu ◇◆◇

The menu can be selected with one of the following methods.
A: Press the numeral key for the No. of the item to be selected.
B: Using the [↓] and [↑] keys, etc., move the cursor to the item to be selected, and then press the [INP] key.

(5) Inputting the origin data



Input the value confirmed in page 13, "(1) Confirming the origin data".
The correspondence of the origin data label value and axis to be input is shown in Fig. 2-9.

Fig.2-9 : Correspondence of origin data label and axis

The method for inputting the origin data is explained below. The value shown in Fig. 2-8 will be input as an example.

<T/B screen> [Keys used]

<DATA>D(0)00000)
1:000000 000000
3:000000 000000
5:000000 000000

1) Confirm that the cursor is at the "D" position on the T/B display screen.

<DATA>D(V00000)
1:000000 000000
3:000000 000000
5:000000 000000

POS CHAR + +B (J5) 6 VWX

2) Input the D value V!%S29.
Inputting "V"
Press the [VWX] key once while holding down the [CHAR] key. "V" will appear, so release the [CHAR] key. "V" will be set.

<DATA>D(V!0000)
1:000000 000000
3:000000 000000
5:000000 000000

POS CHAR + SPD #%!

Inputting "!"
Press the [#%] key three times while holding down the [CHAR] key. "!" will appear, so release the [CHAR] key. "!" will be set.

<DATA>D(V!%000)
1:000000 000000
3:000000 000000
5:000000 000000

POS CHAR + SPD #%!
POS CHAR + +C (J6) 5 STU
−A (J4) 2 GHI
+Y (J2) 9 &<>

In the same manner, while holding down the [CHAR] key, press the ["%"] key twice, and the [STU] key once (input "S").
Release the [CHAR] key, and press the [2] key (input "2") and then the [9] key (input "9").
V!%S29 will appear at the "D" data on the teaching pendant screen.

<DATA>D(V!%S29)
1:000000 000000
3:000000 000000
5:000000 000000

RPL ↓

3) Press the [↓] key, and move the cursor to the J1 input position.
4) Input the J1 value in the same manner as above.

<DATA>D(V!%S29)
1:A@B&8F
G#$Y5#
3:H+7%2H B="!1L

INP EXE

5) Input the J2, J3 and J4 values in the same manner.
6) After inputting all of the values, press the [INP] key. The origin setting confirmation screen will appear.

<DATA>D(V!%S29)
CHANGES TO ORIGIN
OK? ( )
:EXECUTE

−B (J5) 1 DEF
INP EXE

7) [Press [1] (−B/−P) and [INP] key to end the origin setting.

◇◆◇ Moving the cursor ◇◆◇

Press the [↑], [↓], [←] and [→] keys.

◇◆◇ Inputting characters ◇◆◇

Hold down the [CHAR] key and press the key with the character to be input on the lower right. Three characters will scroll each time the character key is pressed.

◇◆◇ Correcting an input ◇◆◇

After returning one character by pressing the [DEL] key, input the character again.

(6) Installing the battery cover

Return the battery cover, removed in page 13, "(1) Confirming the origin data" to its original position.
This completes the setting of the origin with the origin data input method.

⚠ WARNING

Always remove and install the cover with the controller power turned OFF. Failure to do so could lead to the robot moving because of incorrect operations, or to physical damage or personal injury.

◇◆◇ If the origin input data is incorrect ◇◆◇

If the origin input data is incorrect, the alarm No. 1760 (origin setting data illegal) will occur when origin data input. In this case, reconfirm the value input for the origin data.

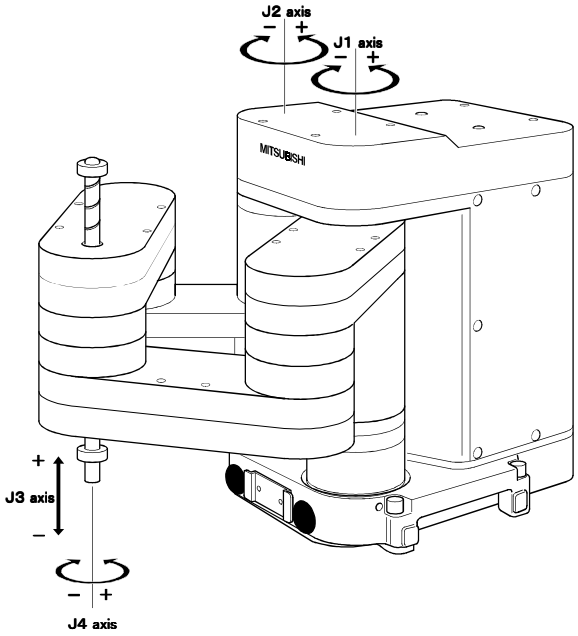
2.4 Confirming the operation

In this section, the robot will be moved manually using the T/B to confirm that the operation is correct.
Moving the robot manually is called "jog operation". This operation includes the JOINT jog that moves each axis, the XYZ jog that moves along the base coordinate system, the TOOL jog that moves along the tool coordinate system, and the CYLNDER jog that moves along the circular arc.
This operation is carried out while pressing the deadman switch on the back of the T/B.

⚠ CAUTION The robot will move during this operation. Make sure that there are no operators near the robot, and that there are no obstacles, such as tools, in the robot operation range.

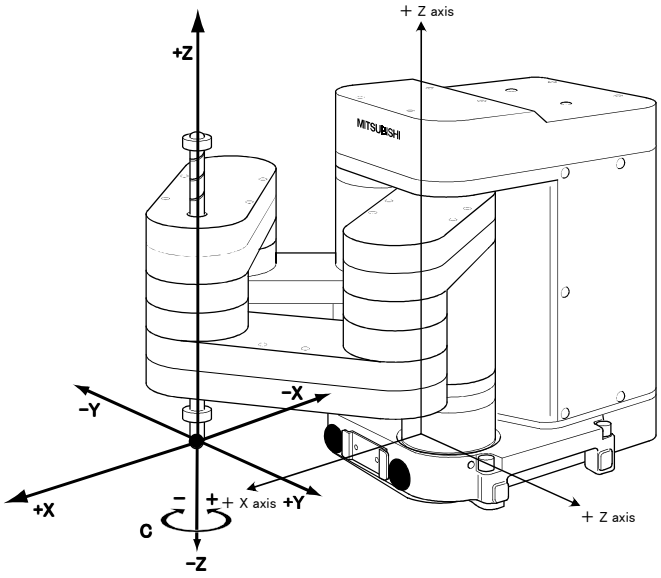
⚠ CAUTION To immediately stop the robot, release the deadman switch on the back of the T/B. The servo power will turn OFF, and the robot will stop.
The robot will also stop if the [EMG.STOP] switch (emergency stop switch) on the front of the T/B or the [EMG.STOP] switch (emergency stop) on the front of the controller is pressed.

⚠ CAUTION Confirm that the origin has been set. If the origin has not been set, "****" will appear at the current position display on the teaching pendant, the JOINT jog operation will take place in any jog mode selected.
Refer to page 12, "2.3 Setting the origin" for details on setting the origin.



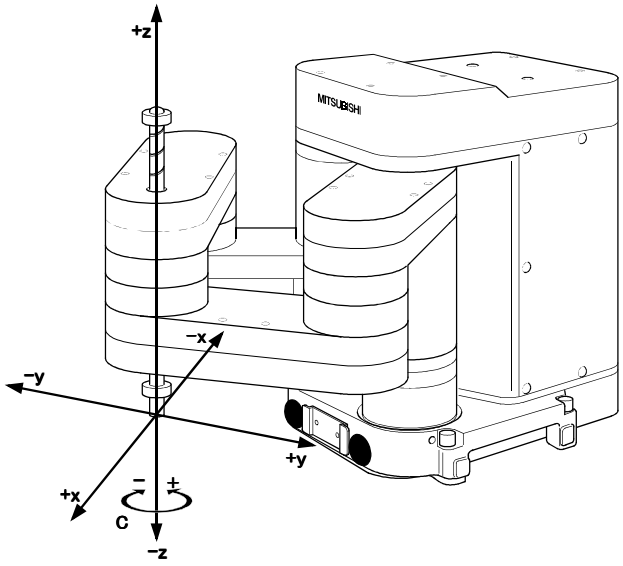
* Each axis moves independently.

Fig.2-10 : JOINT jog operation



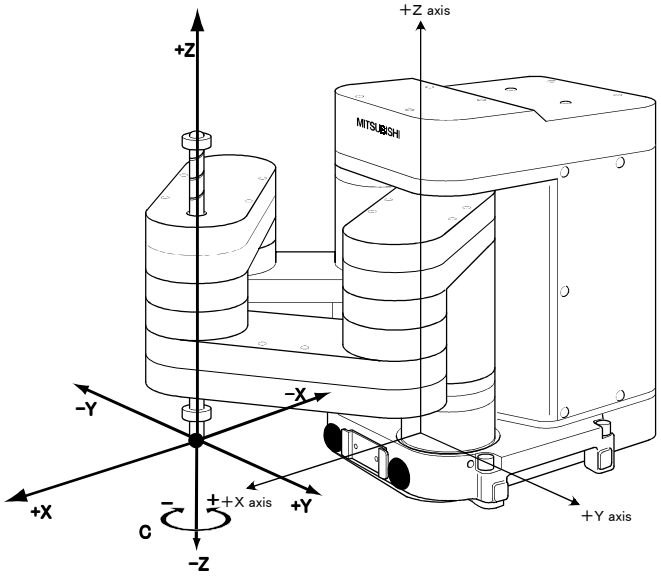
* While maintaining the posture of the end axis, the robot moves straight along the base coordinate system.
The end axis rotates.

Fig.2-11 : XYZ jog operation



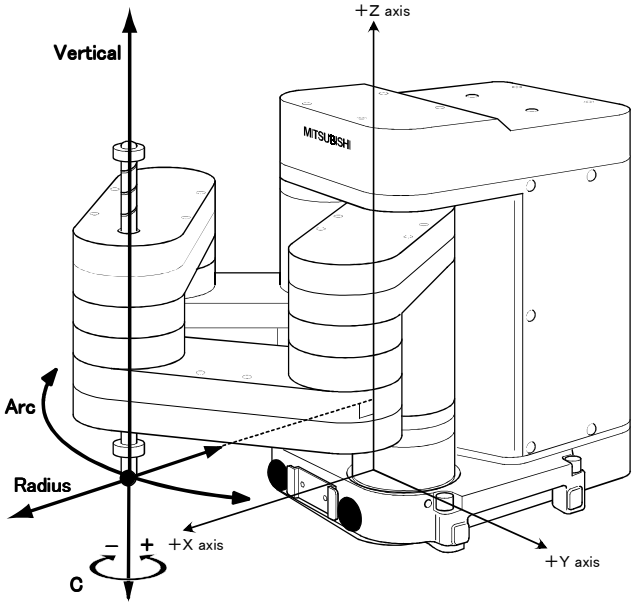
* While maintaining the posture of the end axis, the robot moves straight along the tool coordinate system.
The end axis changes directions while maintaining its position.

Fig.2-12 : TOOL jog operation



* The robot moves straight along the base coordinate system. The direction of the end axis is not maintained during this type.
The direction of the end axis changes. At this time, the end axis position will change.

Fig.2-13 : 3-axis XYZ jog operation

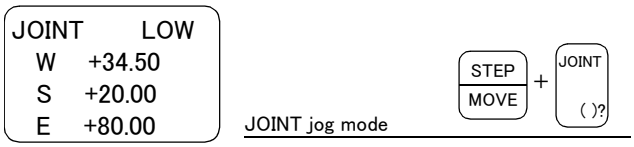


* With an arc using the end axis position as the center of the Z axis, the robot moves over the arc, expands and contracts in the radial direction, and moves vertically. At this time, the posture of the end axis is maintained. The direction is changed while maintaining the end axis position.

Fig.2-14 : CYLNDER jog operation

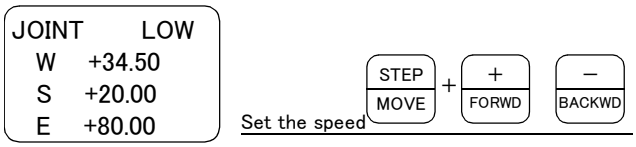
(1) JOINT jog operation

Select the JOINT jog mode



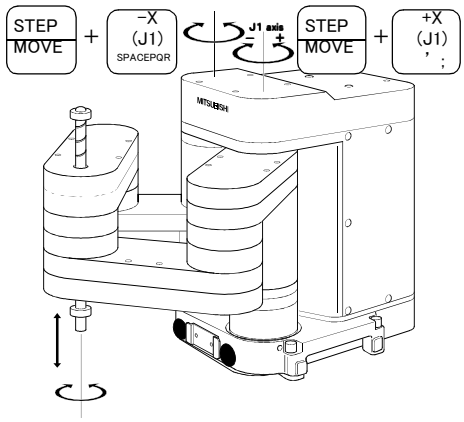
Press the [MOVE] + [JOINT] keys to select the JOINT jog mode. "JOINT" will appear at the upper left of the screen.

Set the jog speed



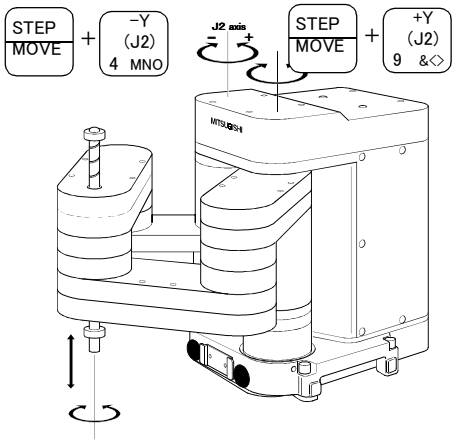
Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%.
When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order.
The currently set speed will appear on the upper right of the screen.
Set the override to 10% here for confirmation work.

J1 axis jog operation



When the [MOVE] + [+X (J1)] keys are pressed, the J1 axis will rotate in the plus direction.
When the [MOVE] + [−X (J1)] keys are pressed, the J1 axis will rotate in the minus direction.

J2 axis jog operation

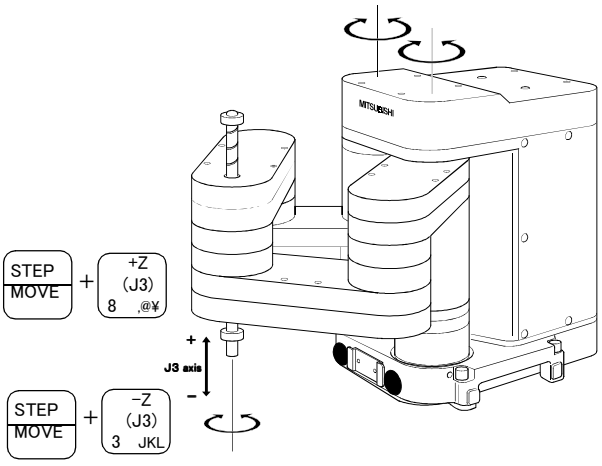


When the [MOVE] + [+Y (J2)] keys are pressed, the J2 axis will rotate in the plus direction.
When the [MOVE] + [−Y (J2)] keys are pressed, the J2 axis will rotate in the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇

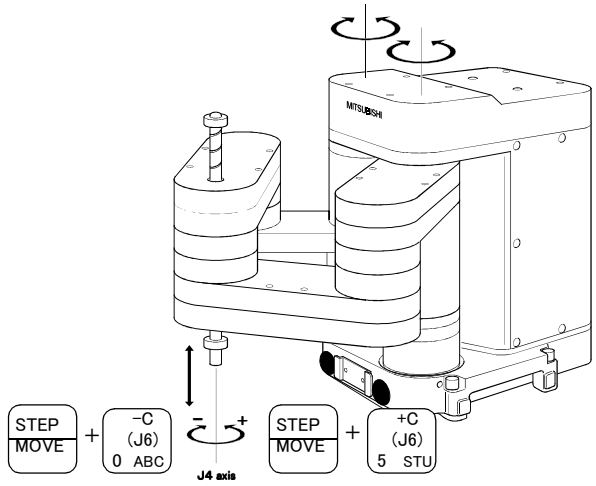
The axes may be outside the movement area. Move these axes toward the inner side of the movement area. If moved outward, an X will appear on the T/B screen, and the robot will not move.

J3 axis jog operation



When the [MOVE] + [+Z (J3)] keys are pressed, the J3 axis will rotate in the plus direction (up).
When the [MOVE] + [−Z (J3)] keys are pressed, the J3 axis will rotate in the minus direction (down).

J4 axis jog operation



When the [MOVE] + [+A (J4)] keys are pressed, the J4 axis will rotate in the plus direction.
When the [MOVE] + [−A (J4)] keys are pressed, the J4 axis will rotate in the minus direction.

◇◆◇ When an X appears on the T/B screen display ◇◆◇

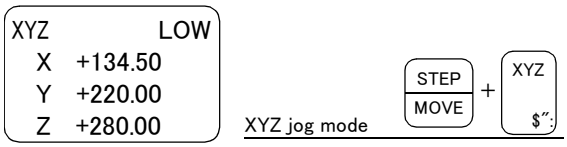
If the robot is moved outside the movement area, an X will appear. In this case, move the axis in the opposite direction.

JOINT	LOW
XW	+160.00
S	+20.00
E	+80.00

In the example on the left, the J1 axis is at the limit of the plus side movement area.

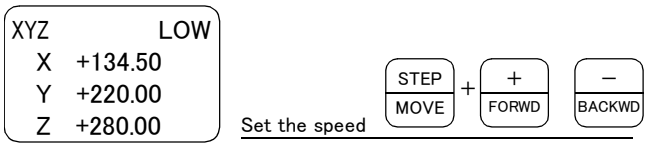
(2) XYZ jog operation

Select the XYZ jog mode



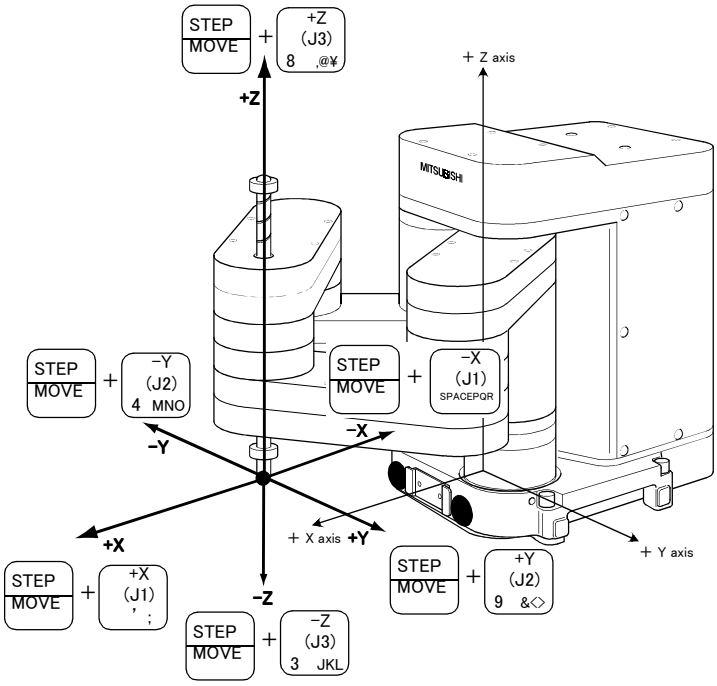
Press the [MOVE] + [XYZ] keys to select the XYZ jog mode. "XYZ" will appear at the upper left of the screen.

Set the jog speed



Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along the base coordinate system



∗ The direction of the end axis will not change.

∗ Moving along the X axis
When the [MOVE] + [+X (J1)] keys are pressed, the robot will move along the X axis plus direction.
When the [MOVE] + [−X (J1)] keys are pressed, the robot will move along the minus direction.

∗ Moving along the Y axis
When the [MOVE] + [+Y(J2)] keys are pressed, the robot will move along the Y axis plus direction.
When the [MOVE] + [−Y (J2)] keys are pressed, the robot will move along the minus direction.

∗ Moving along the Z axis
When the [MOVE] + [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
When the [MOVE] + [−Z (J3)] keys are pressed, the robot will move along the minus direction.
The direction of the end axis will not move.

◇◆◇ When the robot is in the transportation posture ◇◆◇

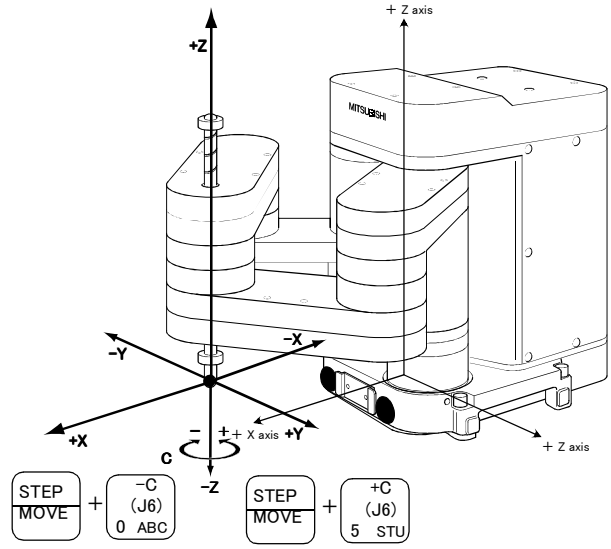
There are directions from which linear movement is not possible from the transportation posture. In this case, an X will appear on the T/B screen, and the robot will not move. Refer to page 21, "(1) JOINT jog operation", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◇◆◇ When an X appears on the T/B screen display ◇◆◇

If the robot is moved outside the movement area with any of the axes, an X will appear. In this case, move the axis in the opposite direction.

In the example on the left, further linear movement in the same direction is not possible.

Changing the direction of the end axis



* The Position of the end axis will not change.

* Rotating around the Z axis
  When the [MOVE] + [+C (J6)] keys are pressed, the Z axis will rotate in the plus direction.
  When the [MOVE] + [−C (J6)] keys are pressed, the Z axis will rotate in the minus direction.
  The position of the end axis will not move.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

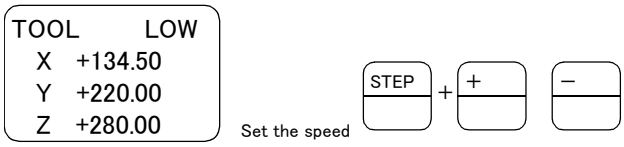
The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(3) TOOL jog operation

Select the TOOL jog mode

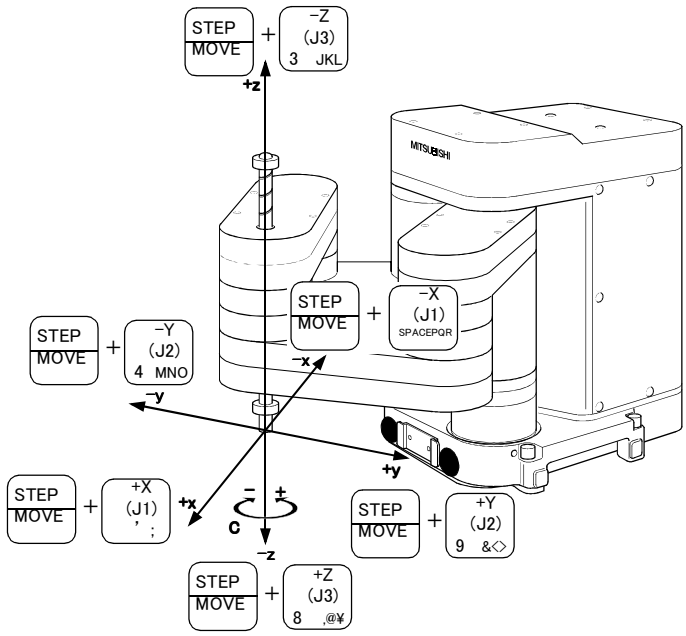
Press the [MOVE] + [TOOL] keys to select the TOOL jog mode. "TOOL" will appear at the upper left of the screen.

Set the jog speed



Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along the tool coordinate system



* The direction of the frange will not change.

* Moving along the X axis
  When the [MOVE] + [+X (J1)] keys are pressed, the robot will move along the X axis plus direction of the tool coordinate system.
  When the [MOVE] + [−X (J1)] keys are pressed, the robot will move along the minus direction.

* Moving along the Y axis
  When the [MOVE] + [+Y(J2)] keys are pressed, the robot will move along the Y axis plus direction of the tool coordinate system.
  When the [MOVE] + [−Y (J2)] keys are pressed, the robot will move along the minus direction.

* Moving along the Z axis
  When the [MOVE] + [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction of the tool coordinate system.
  When the [MOVE] + [−Z (J3)] keys are pressed, the robot will move along the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇

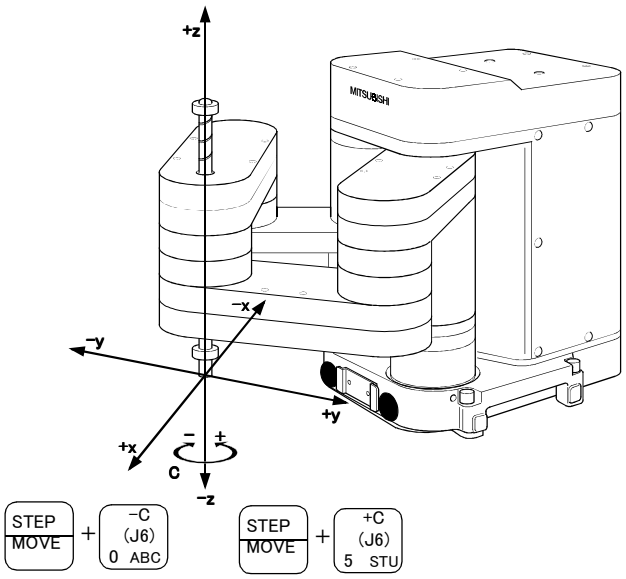
There are directions from which linear movement is not possible from the transportation posture. In this case, an X will appear on the T/B screen, and the robot will not move. Refer to page 21, "(1) JOINT jog operation", and move the robot to a position where linear movement is possible, and then carry out TOOL jog.

◇◆◇ When an X appears on the T/B screen display ◇◆◇

If the robot is moved outside the movement area with any of the axes, an X will appear. In this case, move the axis in the opposite direction.

In the example on the left, further linear movement in the same direction is not possible.

Rotating the end axis



* The position of the end axis will not change.

* Rotating around the Z axis
  When the [MOVE] + [+C (J6)] keys are pressed, the Z axis will rotate in the plus direction of the tool coordinate system.
  When the [MOVE] + [−C (J6)] keys are pressed, the Z axis will rotate in the minus direction.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

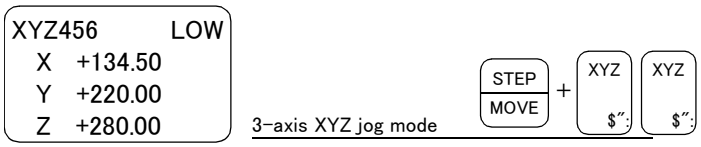
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

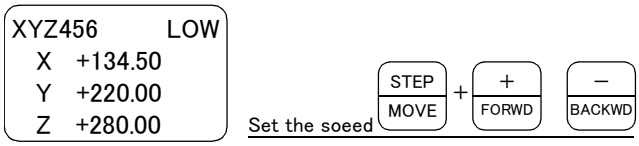
(4) 3-axis XYZ jog operation

Select the 3-axis XYZ jog mode



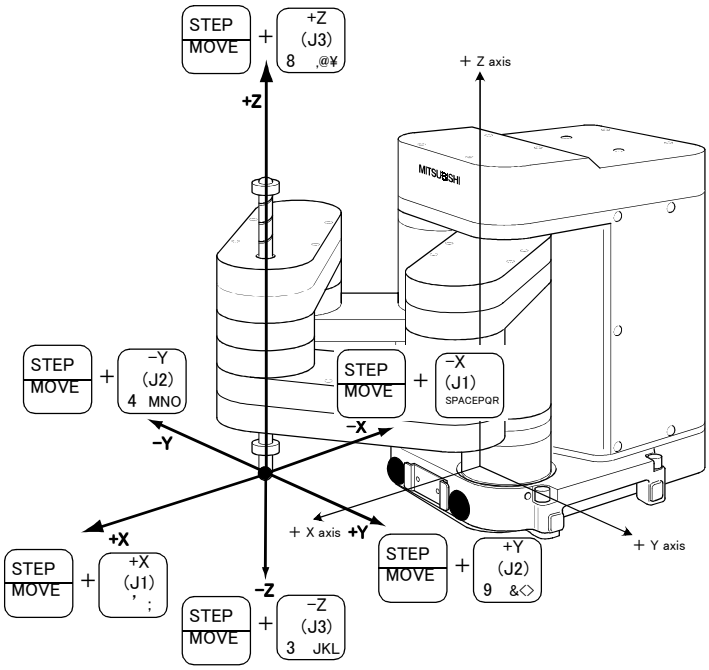
Press the [MOVE] + [XYZ] keys, and then press only the [XYZ] key. "XYZ456" will appear at the upper left of the screen.

Set the jog speed



Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along the base coordinate system



* The direction of the end axis will not change.

* Moving along the X axis
  When the [MOVE] + [+X (J1)] keys are pressed, the robot will move along the X axis plus direction.
  When the [MOVE] + [−X (J1)] keys are pressed, the robot will move along the minus direction.

* Moving along the Y axis
  When the [MOVE] + [+Y(J2)] keys are pressed, the robot will move along the Y axis plus direction.
  When the [MOVE] + [−Y (J2)] keys are pressed, the robot will move along the minus direction.

* Moving along the Z axis
  When the [MOVE] + [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
  When the [MOVE] + [−Z (J3)] keys are pressed, the robot will move along the minus direction.

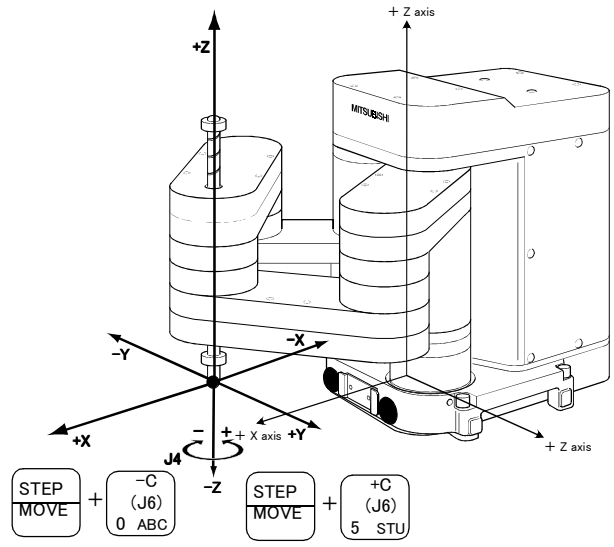
◇◆◇ Jog mode will change when only [XYZ] key is pressed again ◇◆◇

When the [MOVE] + [XYZ] keys are pressed and then only the [XYZ] key is pressed, the upper left display will change in the order of "XYZ" → "XYZ456" → "CYLNDER". Each jog mode can be selected.

◇◆◇ The end axis posture cannot be maintained with 3-axis XYZ jog. ◇◆◇

With 3-axis XYZ jog, the end axis posture (orientation) is not maintained when moving linearly in the X, Y or Z axis direction. Use XYZ jog to maintain the posture.

Changing the end axis direction

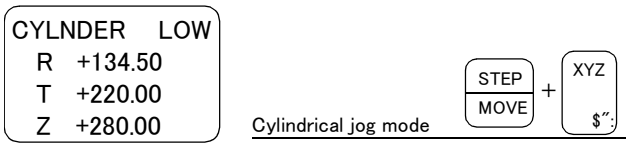


* The position of the end axis will not change.

* Rotating around the Z axis
  When the [MOVE] + [+C (J6)] keys are pressed, the Z axis will rotate in the plus direction.
  When the [MOVE] + [−C (J6)] keys are pressed, the Z axis will rotate in the minus direction.

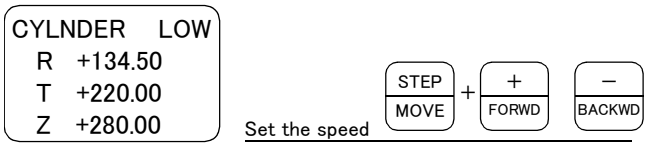
(5) CYLNDER jog operation

Select the cylindrical jog mode



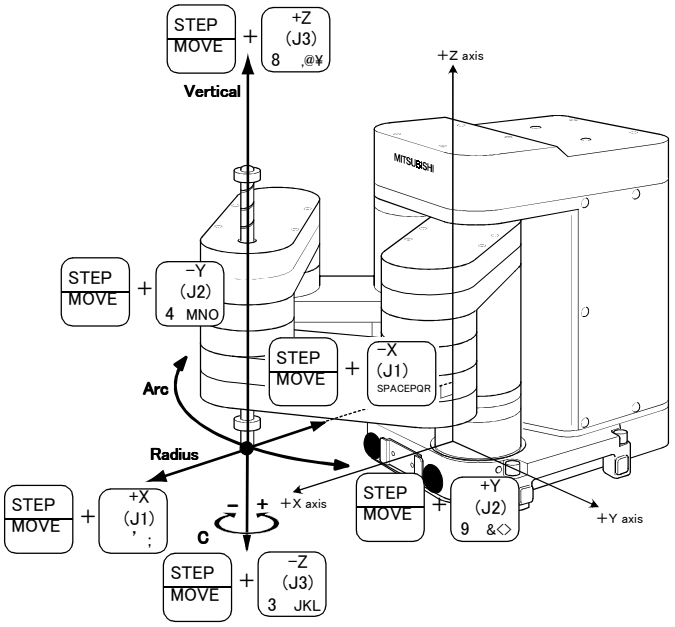
Press the [MOVE] + [XYZ] keys, and then press only the [XYZ] key. "CYLNDER" will appear at the upper left of the screen.

Set the jog speed



Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along an arc centering on the Z axis



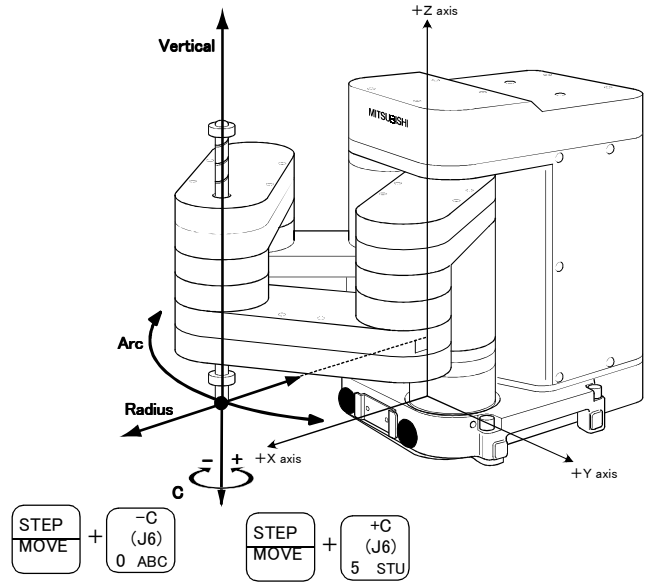
＊ The direction of the frange will not change.

＊ Moving along an arc
Assuming that the current position is on an arc centering on the Z axis, the robot moves along that arc.
When the [MOVE] + [+Y (J2)] keys are pressed, the robot will move along the arc in the plus direction.
When the [MOVE] + [−Y (J2)] keys are pressed, the robot will move in the minus direction.

＊ Moving in the radial direction
Assuming that the current position is on an arc centering on the Z axis, the robot will expand and contract in the radial direction.
When the [MOVE] + [+X (J1)] keys are pressed, the robot will expand in the radial direction
When the [MOVE] + [+X (J1)] keys are pressed, the robot will contract in the radial direction

＊ Moving along the Z axis
When the [MOVE] + [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
When the [MOVE] + [−Z (J3)] keys are pressed, the robot will move along the minus direction.

Changing the end axis direction



* The position of the end axis will not change.

* Rotating around the Z axis
  When the [MOVE] + [+C (J6)] keys are pressed, the Z axis will rotate in the plus direction.
  When the [MOVE] + [−C (J6)] keys are pressed, the Z axis will rotate in the minus direction.

3 Installing the option devices

3.1 Installing the solenoid valve set (1A-VD04-RP/1A-VD04E-PR)

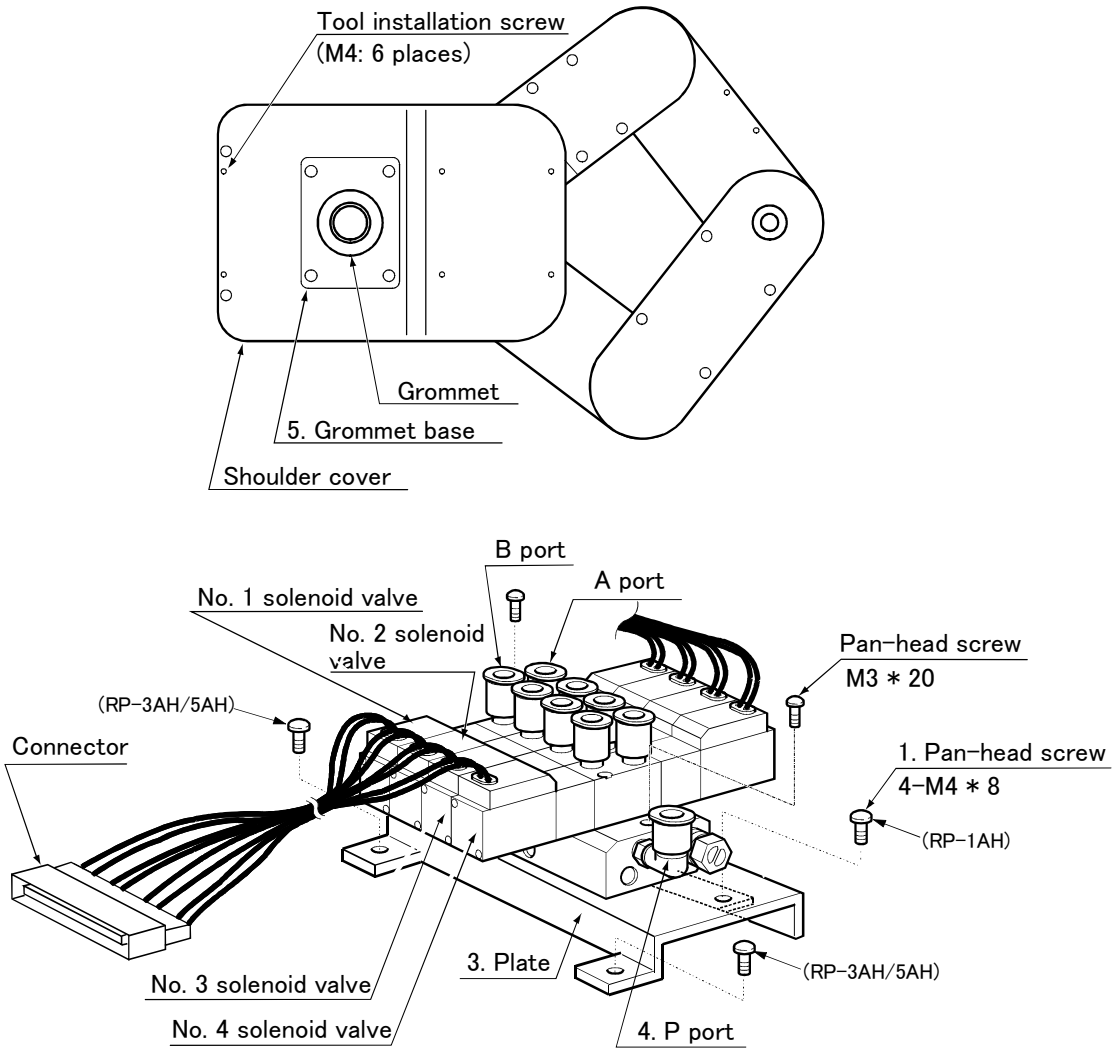


Fig.3-1 : Solenoid valve installation procedures

The procedures for installing the solenoid valve and connecting the connector are shown in Fig. 3-1. The installation procedures are as follow.

1) Using the tool installation screw holes (M4 screws; 6 places) on the top of the shoulder cover, install the plate 3 onto which the solenoid valve is installed.
2) Connect the user-prepared air hose ϕ6 to the quick-coupling (P port) 4 of the solenoid valve.
3) Remove the grommet base 5 installed on the top of the shoulder cover.
4) Using a knife, cut the center of the grommet on the removed grommet base 5. Pass the solenoid valve side connector through the hole, and connect to the connector (GR) installed on the connector base.
5) Return the grommet base 5 to its original position.

4 Basic operations

The basic operations from creating the program to automatic operation are explained in section ″4. Basic operations″ in the ″From Controller Setup to Maintenance″ manual. Refer that manual as necessary.

5 Maintenance and Inspection

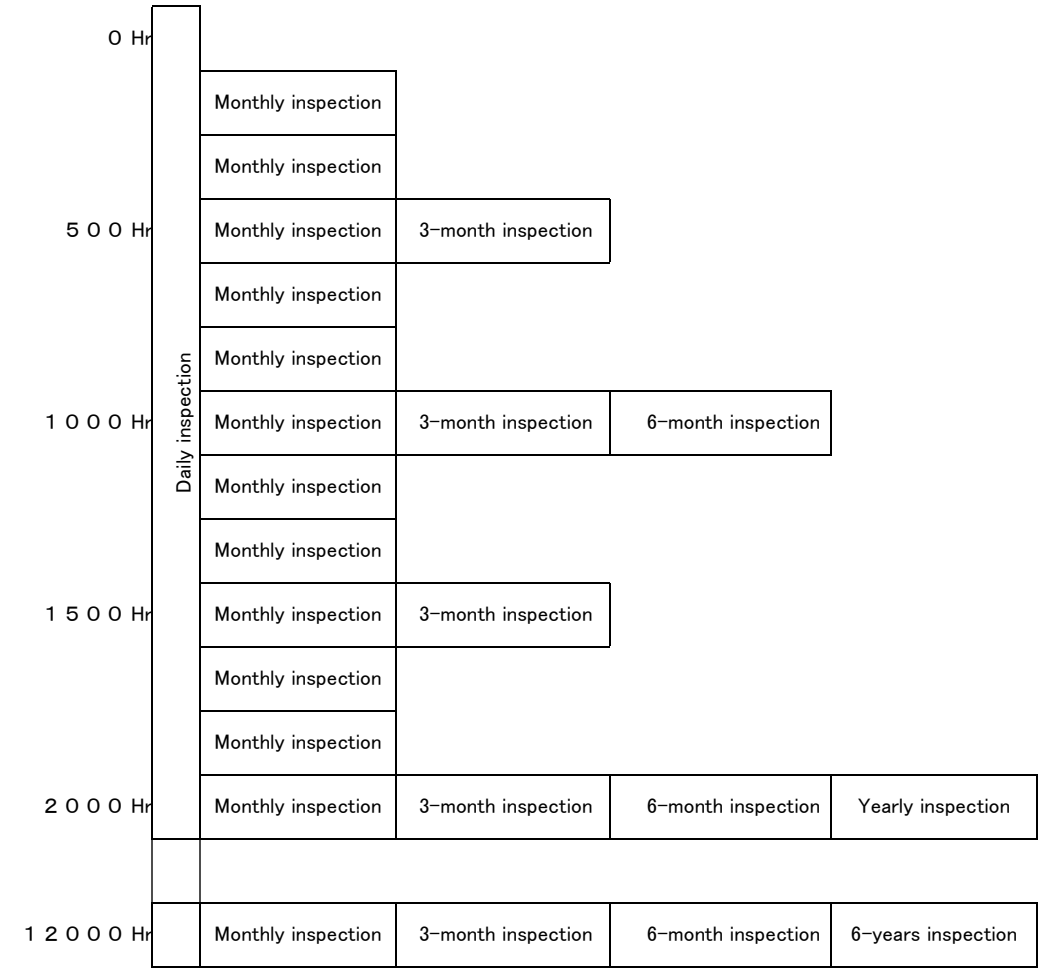
The maintenance and inspection procedures to be carried out to use the robot for a long time without trouble are described in this chapter. The types and replacement methods of consumable parts are also explained.

5.1 Maintenance and inspection interval

Maintenance and inspection are divided into the inspections carried out daily, and the periodic inspections carry out at set intervals. Always carry these out to prevent unforeseen trouble, to maintain the product for a long time, and to secure safety.

(1) Inspection schedule

In addition to the monthly inspection, add the following inspection items every three months (estimated at 500 Hr operation hours).



<Guideline for inspection period>

For one shift

8 Hr/day x 20 days/month x 3 months = approx. 500 Hr

10 Hr/day x 20 days/month x 3 months = approx. 600 Hr

For two shifts

15 Hr/day x 20 days/month x 3 months = approx. 1000 Hr

[Caution] When using two lines, the 3-month inspection, 6-month inspection and yearly inspection must be carried out when half the time has passed.

Fig.5-1 : Inspection schedule

5.2 Inspection items

The inspection items for the robot arm are shown below.
Also refer to section "5 Maintenance and Inspection" in the "Controller setup, basic operation, and maintenance" manual, and inspect the controller.

5.2.1 Daily inspection items

Carry out the daily inspections with the procedures given in Table 5-1.

Table 5-1 : Daily inspection items (details)

Procedure	Inspection item (details)	Remedies
Before turning power ON (Check the following items before turning the power ON.)		
1	Are any of the robot installation bolts loose? (Visual)	Securely tighten the bolts.
2	Are any of the cover tightening screws loose? (Visual)	Securely tighten the screws.
3	Are any of the hand installation bolts loose? (Visual)	Securely tighten the bolts
4	Is the power supply cable securely connected? (Visual)	Securely connect.
5	Is the machine cable between the robot and controller securely connected? (Visual)	Securely connect.
6	Are there any cracks, foreign contamination or obstacles on the robot and controller cover?	Replace with a new part, or take remedial measures.
7	Is any grease leaking from the robot arm? (Visual)	After cleaning, replenish the grease.
8	Is there any abnormality in the pneumatic system? Are there any air leaks, drain clogging or hose damage? Is the air source normal? (Visual)	Drain the drainage, and remedy the air leaks (replace the part).
After turning the power ON (Turn the power ON while monitoring the robot.)		
1	Is there any abnormal motion or abnormal noise when the power is turned ON?	Follow the troubleshooting section.
During operation (try running with an original program)		
1	Check whether the movement points are deviated? Check the following points if there is any deviation. 1. Are any installation bolts loose? 2. Are any hand installation section bolts loose? 3. Are the positions of the jigs other than the robot deviated? 4. If the positional deviation cannot be corrected, refer to "Troubleshooting", check and remedy.	Follow the troubleshooting section.
2	Is there any abnormal motion or abnormal noise? (Visual)	Follow the troubleshooting section.

5.2.2 Periodic inspection

Carry out periodic inspection with the procedures given in Table 5-2.

Table 5-2 : Periodic inspection items (details)

Procedure	Inspection item (details)	Remedies
Monthly inspection items		
1	Are any of the bolts or screws on the robot arm loose?	Securely tighten the bolts.
2	Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.
3	Remove the cover at each section, and check the cables for wear damage and adherence of foreign matter.	Check and eliminate the cause. If the cables are severely damaged, contact the Mitsubishi Service Department.
4	It runs out of grease on the ball screw?	Lubricate it.(The grease)
3-month inspection items		
1	Is the timing belt tension abnormal?	If the timing belt is loose or too tense, adjust it.
6-month inspection items		
1	Is the friction at the timing belt teeth severe?	If the teeth are missing or severe friction is found, replace the timing belt.
Yearly inspection items		
1	Replace the backup battery in the robot arm.	
6-years inspection items		
1	Lubricate the grease at the harmonic reduction gears for each axis.	

5.3 Maintenance and inspection procedures

The procedures for carrying out the periodic maintenance and inspection are described in this section. Thoroughly read the contents, and follow the instructions. This work can be commissioned to the Mitsubishi Service Department for a fee. (Never disassemble, etc., the parts not described in this manual.)
The maintenance parts, etc., required for the user to carry out maintenance and inspection are described in section "5.4 Maintenance parts" on page 53 of this manual. Always contact your dealer when parts are needed.

⚠ CAUTION The origin of the machine system could deviate when this work is carried out. "Review of the position data" and "re-teaching" will be required.

5.3.1 Robot arm structure

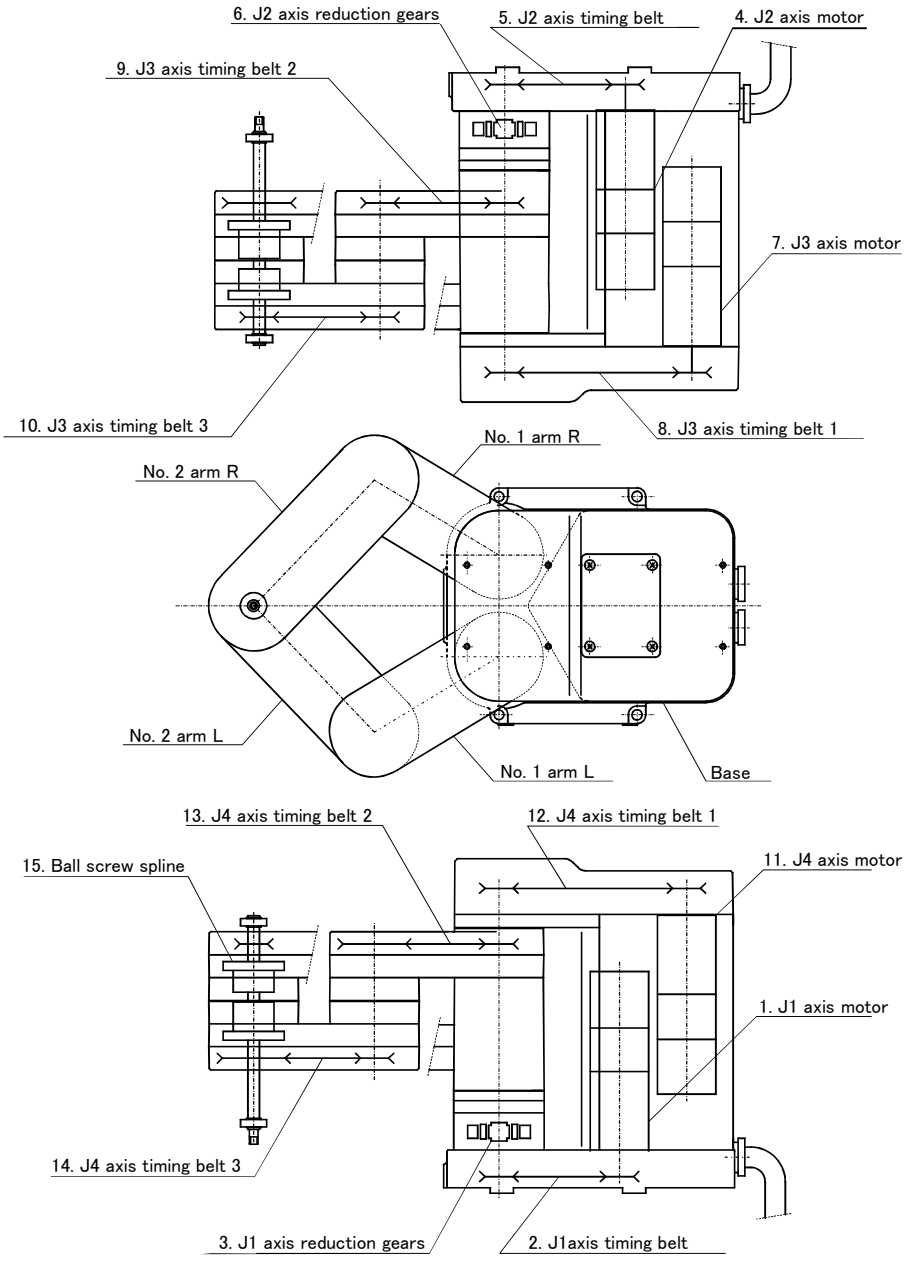

6. J2 axis reduction gears
5. J2 axis timing belt
4. J2 axis motor
9. J3 axis timing belt 2
7. J3 axis motor
10. J3 axis timing belt 3
8. J3 axis timing belt 1
No. 1 arm R
No. 2 arm R
No. 2 arm L
No. 1 arm L
Base
13. J4 axis timing belt 2
12. J4 axis timing belt 1
15. Ball screw spline
11. J4 axis motor
1. J1 axis motor
14. J4 axis timing belt 3
3. J1 axis reduction gears
2. J1axis timing belt

Fig.5-2 : Outline structure of robot arm

(1) J1 axis

The rotation of the J1 axis motor 1 installed on the base, is conveyed through the timing belt 2 to the reduction gears 3 to drive the J1 axis.

Non-excitation magnetic brakes are mounted on the J1 axis motor 1.

(2) J2 axis

The rotation of the J2 axis motor 4 installed on the base, is conveyed through the timing belt 5 to the reduction gears 6 to drive the J2 axis.

As with the J1 axis, non-excitation magnetic brakes are mounted on the J2 axis motor 4.

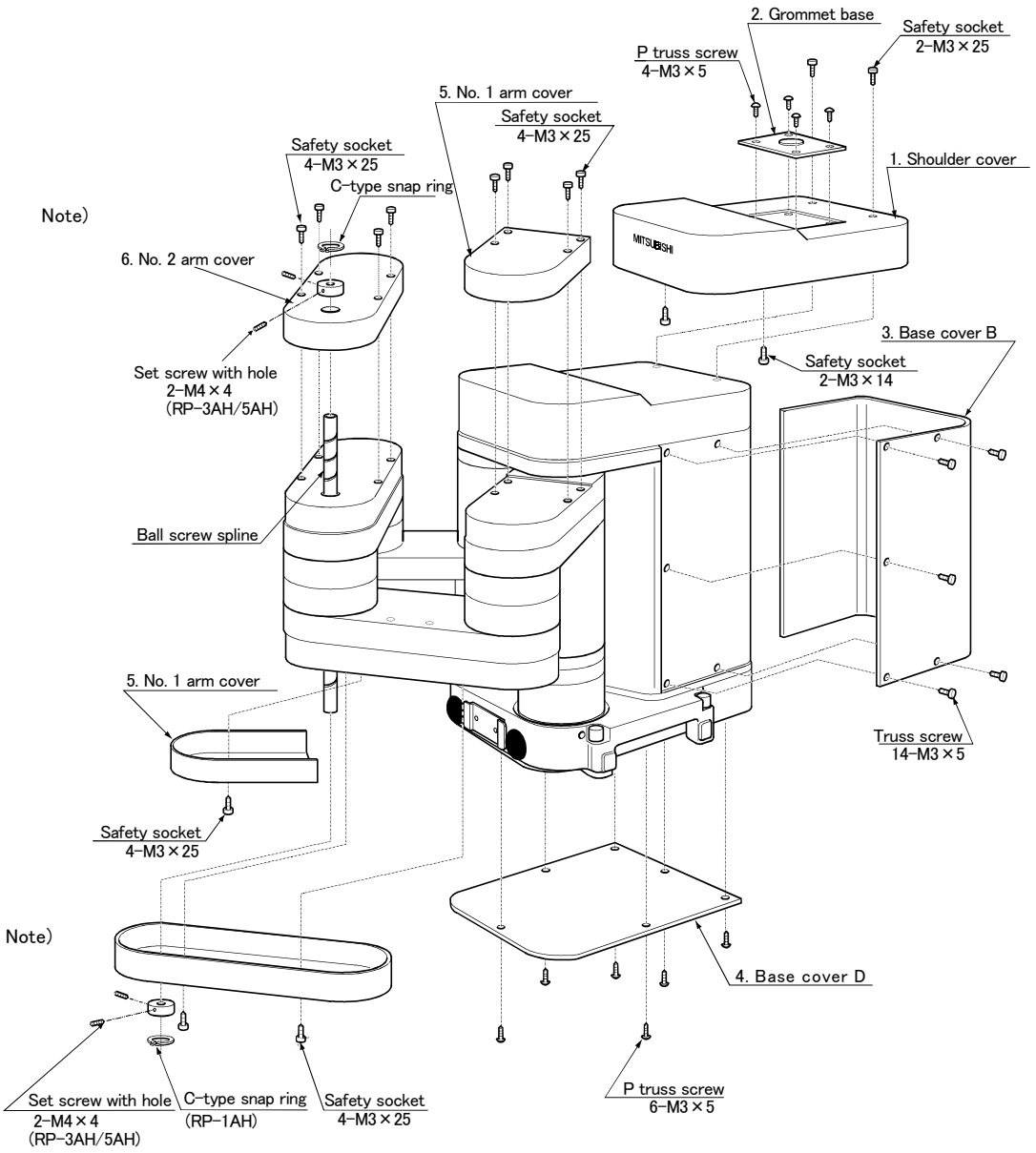
(3) J3 axis

The rotation of the J3 axis motor 7 installed on the base is conveyed through the timing belt 1 8, timing belt 29 and timing belt 3 10, to the ball screw nut of the ball screw spline 15 to drive the J3 axis vertically. As with the J1 axis, non-excitation magnetic brakes are mounted on the J3 axis motor 7.

(4) J4 axis

The rotation of the J4 axis motor 11 installed on the base is conveyed through the timing belt 1 12, timing belt 2 13 and timing belt 3 14, to the spline nut of the ball screw spline 15 to drive the J4 axis.

5.3.2 Installing/removing the cover



Cover installation screw list

No.	Installation screw name	RP-1AH/1AHC-SB		RP-3AH/3AHC-SB RP-5AH/5AHC-SB	
		Size	Q'ty	Size	Q'ty
1	P truss screw	M3 x 5	6	M4 x 8	6
2	Truss screw		14		14
3	Safety socket	M3 x 14	2	M4 x 10	3
4	Safety socket	M3 x 25	2	M4 x 30	2
5	P truss screw	M3 x 5	4	M3 x 5	4
6	Safety socket	M3 x 20	4 each	M3 x 16	4 each
7	Safety socket				
8	Safety socket				
9	Safety socket				

Note)Refer to Fig. 5-4 for installing/ removing of No.2 arm cover in the case of clean type robot.

Fig.5-3 : Installing/removing the cover

(1) Refer to Fig. 5-3 and remove the cover. A list of the cover installation screw is given in the drawing.
(2) When installing the cover after maintenance and inspection, install using the removal procedure in reverse.

⚠CAUTION Be careful not to damage seal stuck on the surface of the clean type and waterproofing type robot cover.
Make contact with dealer when it is damaged. Cleanliness or waterproof performance may not appear when it is used with being damaged.

⚠CAUTION In the case of clean type robot (RP-1AHC-SB/3AHC-SB/5AHC-SB), though the No.2 arm cover can be removed and installed from the arm, it can not be removed and installed from the ball screw spline as shown in the Fig. 5-4.

Fig.5-4 : Installing/removing No.2 arm cover of clean type

5.3.3 Inspecting, servicing, replacing and cleaning the timing belt

This robot uses a timing belt for the drive conveyance system. Compared to gears and chains, the timing belt does not require lubrication and has a low noise. However, if the belt usage method and tension adjustment are inadequate, the life could drop and noise could be generated. Sufficient aging to remove the initial elongation of the belt, and adjustment of the belt tension have been carried out before shipment from the factory.
However, depending on the robot working conditions, elongation will occur gradually over a long time. The tension must be confirmed during the periodic inspection. The timing belt must be replaced in the following cases.

(1) Timing belt replacement period

The timing belt life is greatly affected by the robot working conditions, so a set time cannot be given. However, if the following symptoms occur, replace the belt.

1) When cracks form at the base or back of the belt teeth.
2) When the belt expands due to adherence of oil, etc.
3) When the belt teeth wear (to approx. half of the tooth width).
4) When the belt teeth jump due to belt teeth wear.
5) When the belt snaps.

⚠ CAUTION

Due to the manufacturing of the timing belt, initial wear will occur. Wear chips may accumulate in the cover after approx. 300 Hr of operating the robot, but this is not a fault. If the wear chips appear soon after wiping them off, replace the belt.

⚠ CAUTION

When the belt is replaced, the origin of the machine system could deviate. In this case, review the position data.

(2) Inspecting, adjusting and replacing the upper base timing belt

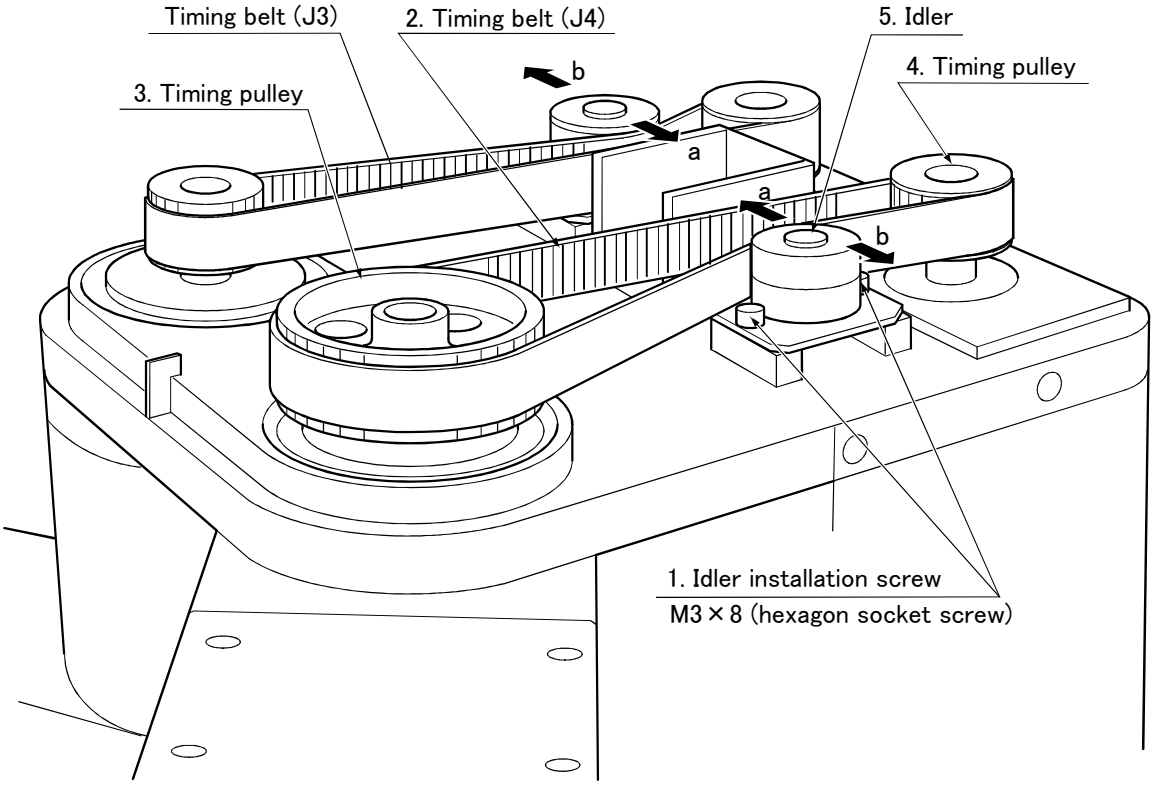


Fig.5-5 : Inspecting, adjusting and replacing the upper base timing belt

■ Inspection method

1) Confirm that the robot controller power is OFF.
2) Following "Fig. 5-3 Installing/removing the cover" on page 40 remove the shoulder cover.
3) Visually check that the symptoms listed in "(1) Timing belt replacement period" on page 42 above have not occurred on the belt.
4) Refer to "(6) Timing belt tension" on page 48 for the belt tension, and confirm that the belt deflection is adequate.

■ Adjustment method

1) Carry out steps 1) and 2) in the " ■ Inspection method" above.
2) Loosen the two idler screws 1. (Do not loosen too far.)
3) While checking the timing belt 2 tension degree, move the idler 5 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 48.
4) When moved in the direction of arrow a in the drawing, the belt will be tensed, and when moved in the direction of arrow b, the belt will be loosened.
5) Do not loosen the belt too much causing it to come off the timing pulleys 3 and 4, or deviate the belt and pulley teeth engagement when adjusting the tension. Doing so could cause the machine system's origin to deviate.
6) After adjusting, securely tighten the two idler installation screws 1. If the idler is improperly tightened, it could loosen due to vibration.
7) Adjust the other belt with the same method.

■ Replacement method

1) Carry out steps 1) and 2) in the " ■ Inspection method" above.
2) Loosen the two idler installation screws 1.
3) Remove the old belt, and install a new one.
4) Move the idler 5 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 48.
5) After replacing the belt, refer to "5.5 Resetting the origin" on page 55, and reset the origin.

(3) Inspecting, adjusting and replacing the lower base timing belt

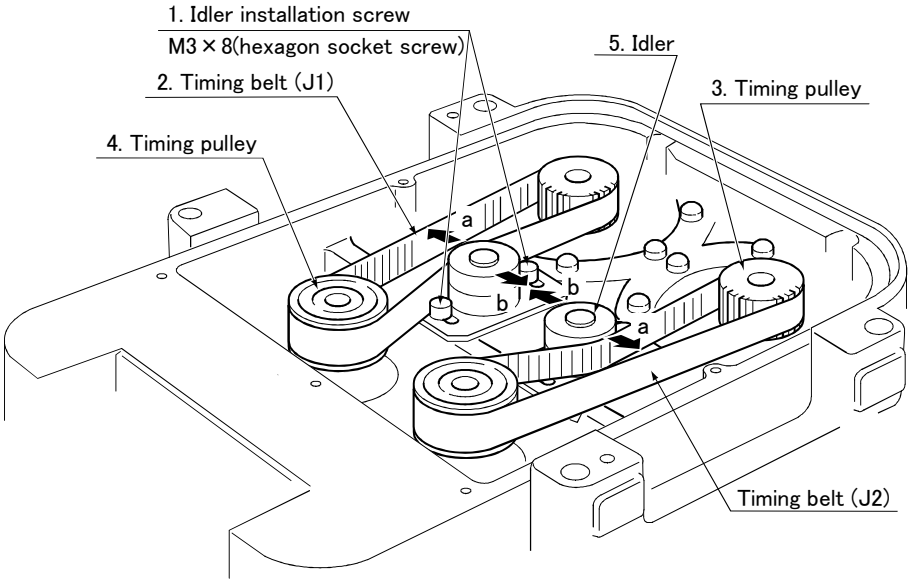


Fig.5-6 : Inspecting, adjusting and replacing the lower base timing belt

■ Inspection method

1) Move the robot to near the following position by jog operation.
   Position RP-1AH/1AHC-SB : (X,Y,Z) = (95,0,0)
   Except for the above : (X,Y,Z) = (175,0,0)
2) Turn the robot controller power OFF.
3) Referring to Fig. 5-6, install so that the robot arm installation surface faces upward.

⚠CAUTION Take special care so that the load is not applied on the ball screw spline axis when the robot is tilted.

4) Following "Fig. 5-3 Installing/removing the cover" on page 40, remove the base cover D.
5) Visually check that the symptoms listed in "(1) Timing belt replacement period" on page 42 above have not occurred on the belt.
6) Refer to "(6) Timing belt tension" on page 48" for the belt tension, and confirm that the belt deflection is adequate.

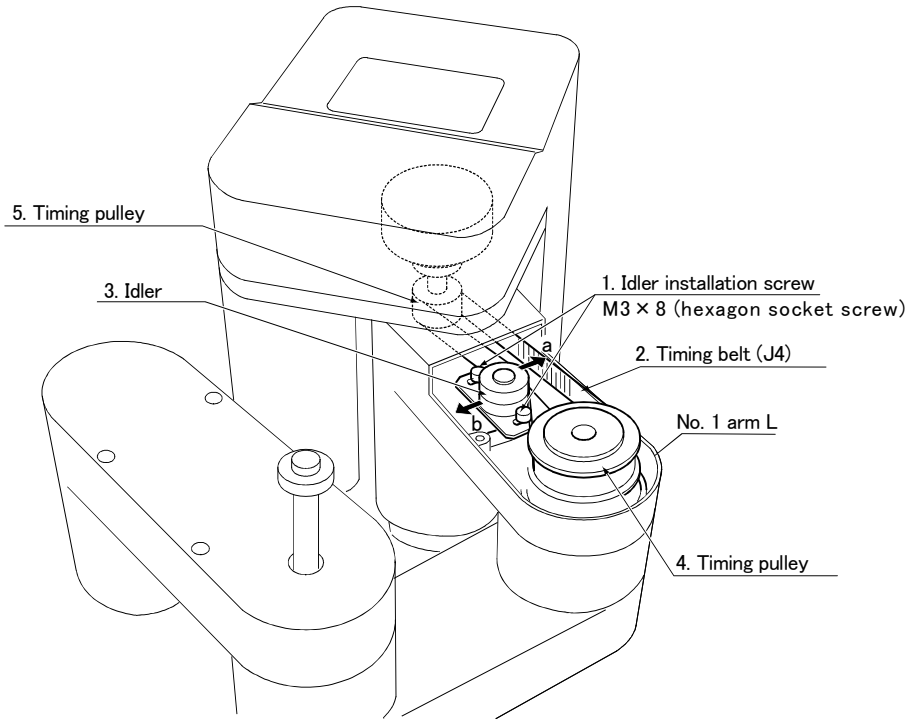
■ Adjustment method

1) Carry out steps 1) and 2) in the " ■ Inspection method" above.
2) Loosen the two idler screws 1. (Do not loosen too far.)
3) While checking the timing belt 2 tension degree, move the idler 5 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 48.
4) When moved in the direction of arrow a in the drawing, the belt will be tensed, and when moved in the direction of arrow b, the belt will be loosened.
5) Do not loosen the belt too much causing it to come off the timing pulleys 3 and 4, or deviate the belt and pulley teeth engagement when adjusting the tension. Doing so could cause the machine system's origin to deviate.
6) After adjusting, securely tighten the two idler installation screws 1. If the idler is improperly tightened, it could loosen due to vibration.
7) Adjust the other belt with the same method.

■ Replacement method

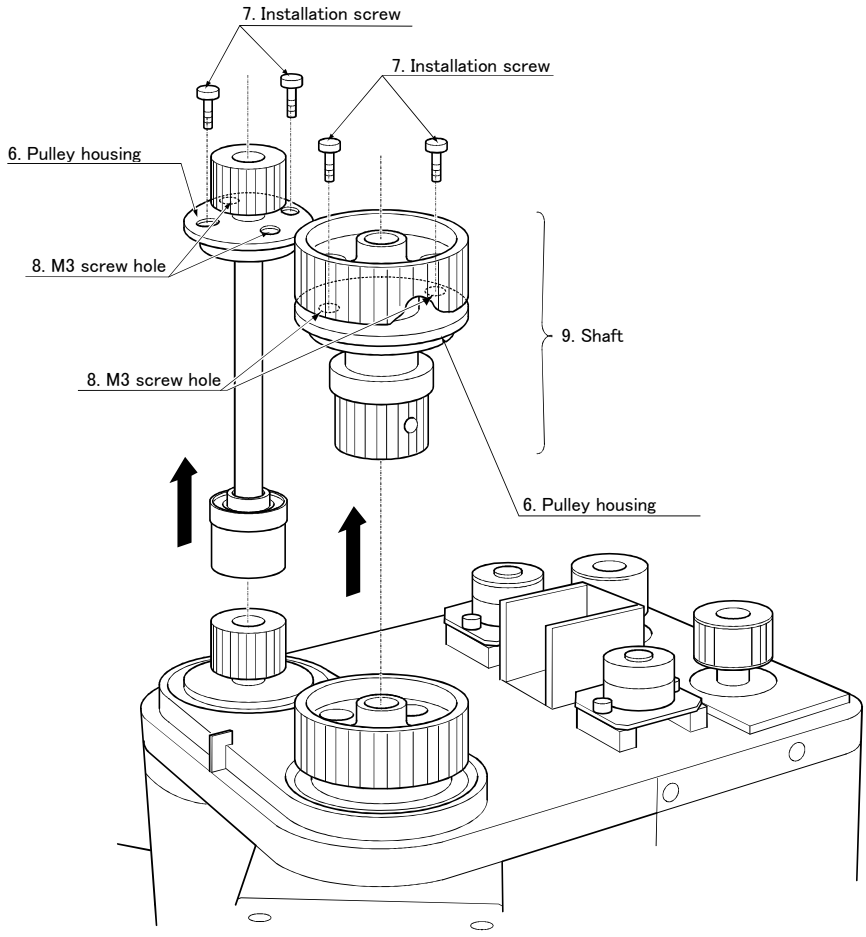
1) Carry out steps 1) and 2) in the " ■ Inspection method" above.
2) Loosen the two idler screws 1.
3) Remove the old belt, and install a new one.
4) Move the idler 5 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 48.
5) After replacing the belt, refer to "5.5 Resetting the origin" on page 55, and reset the origin.

(4) Inspecting, adjusting and replacing the timing belt in No. 1 arm



[Caution]
This drawing shows the timing belt for the J4 axis.
The J3 axis timing belt is also mounted with the same structure under the No. 1 arm R on the opposite side.

(a) Inspecting, adjusting and replacing methods



(b) Removing the shaft

Fig.5-7 : Inspecting, adjusting and replacing the timing belt in No. 1 arm

■ Inspection method

1) Confirm that the robot controller power is OFF.
2) Following "Fig. 5-3 Installing/removing the cover" on page 40, remove the No. 1 arm covers (L) and (R).
3) Visually check that the symptoms listed in "(1) Timing belt replacement period" on page 42 above have not occurred on the belt.
4) Refer to "(6) Timing belt tension" on page 48 for the belt tension, and confirm that the belt deflection is adequate.

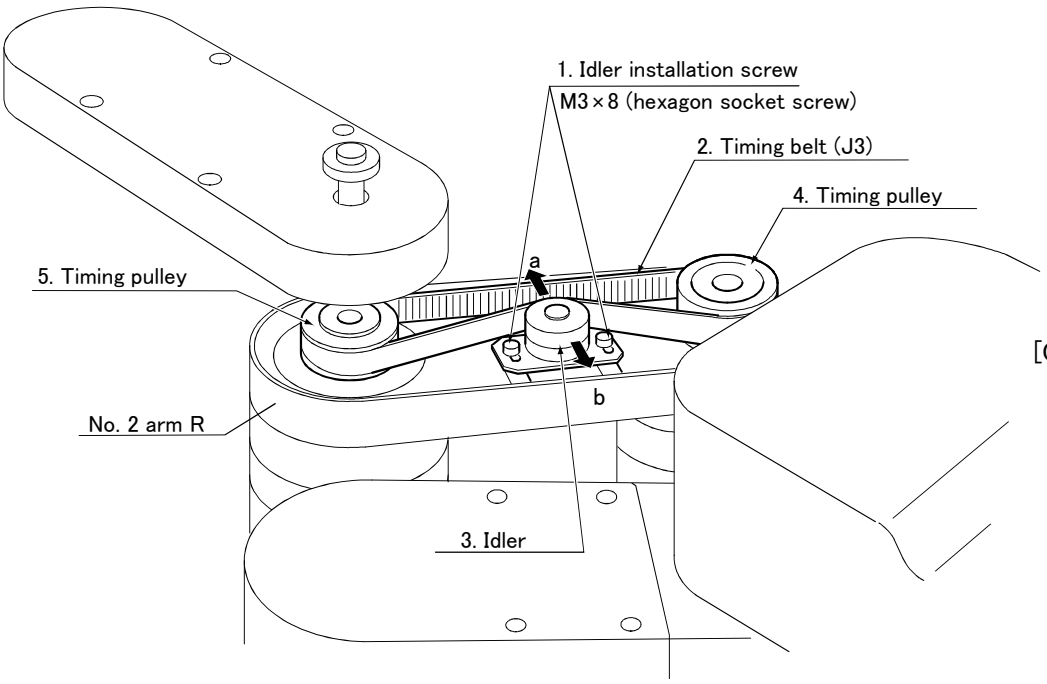
■ Adjustment method

1) Carry out steps 1) and 2) in the " ■ Inspection method" above.
2) Loosen the two idler screws 1. (Do not loosen too far.)
3) While checking the timing belt 2 tension degree, move the idler 3 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 48.
4) When moved in the direction of arrow a, the belt will be tensed, and when moved in the direction of arrow b, the belt will be loosened.
5) Do not loosen the belt too much causing it to come off the timing pulleys 4 and 5, or deviate the belt and pulley teeth engagement when adjusting the tension. Doing so could cause the machine system's origin to deviate.
6) After adjusting, securely tighten the two idler installation screws 1. If the idler is improperly tightened, it could loosen due to vibration.

■ Replacement method

1) Carry out steps 1) and 2) in the " ■ Inspection method" above.
2) Loosen the two idler screws 1.
3) Refer to "(2) Inspecting, adjusting and replacing the upper base timing belt" on page 43, and remove the timing belt on the upper base.
4) Remove the two 7 installation screws for the 6 pulley housing fixing the pulley on the front of the robot at the upper base.
5) Pull the shaft installed on the pulley in the direction of the arrow in the drawing, and remove the belt. (If the shaft is rigid and cannot be removed, screw the 7 installation screws, removed previously, into the two 8 M3 screw holes, and tighten each equally. The pulley housing will come off easier.)
6) nstall the new timing belt. Also install the timing belt on the upper base.
7) Adjust the tension referring to "(6) Timing belt tension" on page 48.
8) After replacing the belt, refer to "5.5 Resetting the origin" on page 55, and reset the origin.

(5) Inspecting, adjusting and replacing the timing belt in No. 2 arm



[Caution]
This drawing shows the timing belt for the J3 axis.
The J4 axis timing belt is also mounted with the same structure under the No. 2 arm L on the opposite side.

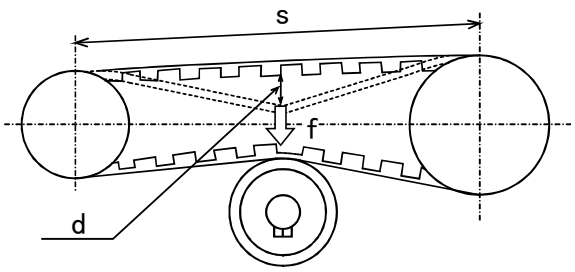
Fig.5-8 : Inspecting, adjusting and replacing the timing belt in No. 2 arm

■ Inspection method
1) Confirm that the robot controller power is OFF.
2) Following "Fig. 5-3 Installing/removing the cover" on page 40, remove the No. 1 arm cover (L) and (R).
3) Visually check that the symptoms listed in "(1) Timing belt replacement period" on page 42 above have not occurred on the belt.
4) Refer to "(6) Timing belt tension" on page 48 for the belt tension, and confirm that the belt deflection is adequate.

■ Adjustment method
1) Carry out steps 1) and 2) in the " ■ Inspection method" above.
2) Loosen the two idler screws 1. (Do not loosen too far.)
3) While checking the timing belt 2 tension degree, move the idler 3 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 48".
4) When moved in the direction of arrow a in the drawing, the belt will be tensed, and when moved in the direction of arrow b, the belt will be loosened.
5) Do not loosen the belt too much causing it to come off the timing pulleys 4 and 5, or deviate the belt and pulley teeth engagement when adjusting the tension. Doing so could cause the machine system's origin to deviate.
6) After adjusting, securely tighten the two idler installation screws 1. If the idler is improperly tightened, it could loosen due to vibration.

■ Replacement method
1) Carry out steps 1) and 2) in the " ■ Inspection method" above.
2) Loosen the two idler screws 1.
3) Remove the old belt, and install a new one.
4) Adjust the tension referring to"(6) Timing belt tension" on page 48.
5) After replacing the belt, refer to "5.5 Resetting the origin" on page 55, and reset the origin.

(6) Timing belt tension



f: Belt pressing force
s: Span length
d: Belt slack

Belt adjustment value

Axis	Part No.	Belt type	Span: s (mm)	Slack: d (mm)	Pressing force: f (N)
Type: RP-1AH/1AHC-SB					
J1 axis	2	２４６－３ＧＴ－９	８６．５	１．３	３．０
J2 axis	5	２４６－３ＧＴ－９	８６．５	１．３	３．０
J3 axis	8	３２７－３ＧＴ－９	１２８	２．０	３．０
	9	２７０－３ＧＴ－９	１００	１．６	３．０
	10	３８２－２ＧＴ－４	１４０	２．０	０．３
J4-axis	12	３６３－３ＧＴ－９	１２７	２．０	３．０
	13	３１５－３ＧＴ－９	１００	１．６	３．０
	14	３９３－３ＧＴ－６	１４０	２．０	１．０
Type: RP-3AH/3AHC-SB					
J1 axis	2	３１８－３ＧＴ－１２	１０７．５	１．７	４．０
J2 axis	5	３１８－３ＧＴ－１２	１０７．５	１．７	４．０
J3 axis	8	４４４－３ＧＴ－９	１７０	２．７	３．０
	9	３７５－３ＧＴ－９	１４０	２．２	３．０
	10	５４３－３ＧＴ－９	２００	３．１	３．０
J4-axis	12	５１３－３ＧＴ－９	１８０	２．８	３．０
	13	４４４－３ＧＴ－９	１４０	２．２	３．０
	14	５５８－３ＧＴ－９	２００	３．１	３．０
Type: RP-5AH/5AHC-SB					
J1 axis	2	３１８－３ＧＴ－１２	１０７．５	１．７	４．０
J2 axis	5	３１８－３ＧＴ－１２	１０７．５	１．７	４．０
J3 axis	8	４４４－３ＧＴ－９	１７０	２．７	３．０
	9	４９５－３ＧＴ－９	２００	３．１	３．０
	10	６６６－３ＧＴ－９	２６０	４．１	３．０
J4-axis	12	５１３－３ＧＴ－９	１８０	２．８	３．０
	13	５６１－３ＧＴ－９	２００	３．１	３．０
	14	６８１－３ＧＴ－９	２６０	４．１	３．０

*The above part numbers correspond to the numbers given in "Fig. 5-2 Outline structure of robot arm" on page 38.

Fig.5-9 : Belt tension

The timing belt can satisfactorily convey the drive and keep a durable force only when it has an adequate tension. The belt tension should not be too tight or too loose. Instead, it should be adjusted to a degree that elasticity is felt when the belt is pressed with the thumb. If the belt tension is too weak, (Range of adjustment of slack: ± 10% of the value) the belt loosening side will vibrate. On the other hand, if the belt tension is too strong, a sharp sound will be heard and the belt tension side will vibrate. If tension adjustment is inadequate, there is a possibility that the position deviates, the belt wears out early, and the bearing which supports the belt breaks down. Please note.
The adjustment value for the tension degree is shown in Fig. 5-9.
Check and adjust with the belt pressing force f and the slack amount d between span s.

5.3.4 Lubrication

(1) Lubrication positions and specifications

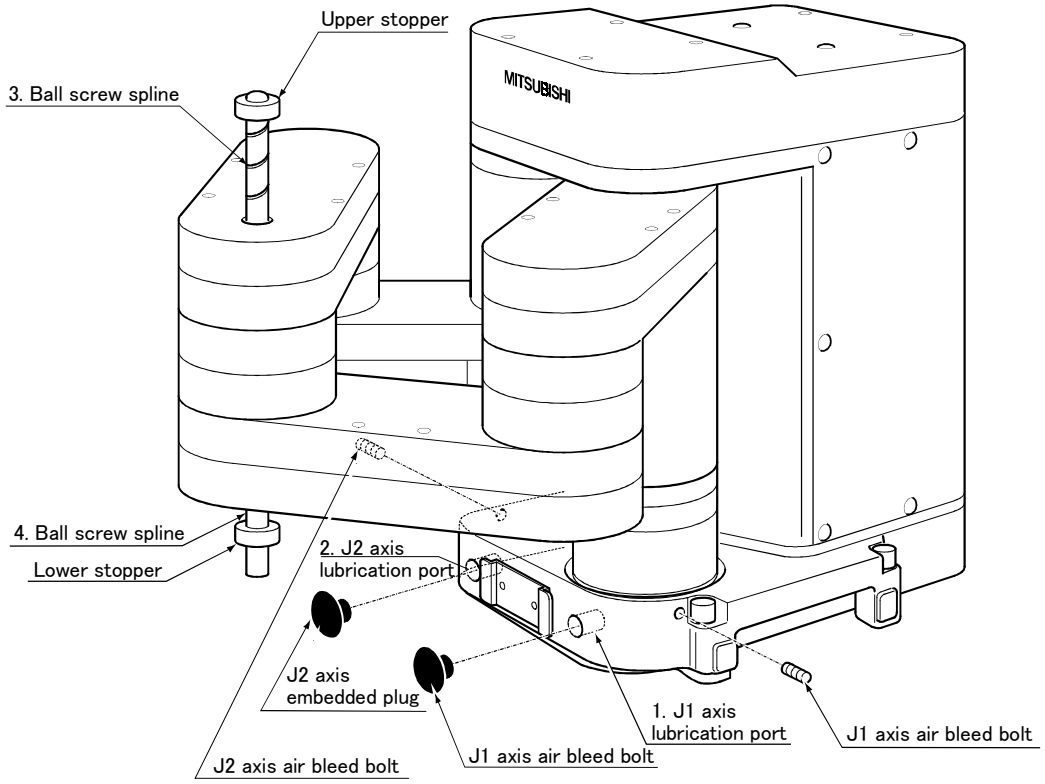


Fig.5-10 : Lubrication positions

Table 5-3 : Lubricant specifications

No.	Lubrication position	Lubrication method	Supplied lubricant Amount charged at shipment	Lubrication time guideline Lubrication amount guideline
1	J1 axis reduction gears	Grease nipple WC-610	Harmonic grease 4B No. 2 RP-1AH/1AHC-SB:0.5g RP-3AH/3AHC-SB:16g RP-5AH-5AHC-SB:16g	12000Hr RP-1AH/1AHC-SB : 3.5g RP-3AH/3AHC-SB : 10g RP-5AH/5AHC-SB : 10g
2	J2 axis reduction gears			
3,4	Ball screw spline	Hand painting	Marutenpu PS No.2 RP-1AH/1AHC-SB: 0.2cc RP-3AH/3AHC-SB: 0.8cc RP-5AH/5AHC-SB: 0.8cc	250Hr RP-1AH/1AHC-SB: 0.2cc RP-3AH/3AHC-SB: 0.8cc RP-5AH/5AHC-SB: 0.8cc

[Caution]

* The brands of grease given in Table 5-3 are those filled when the robot is shipped.
* The lubrication time is a cumulative value of the operation at the maximum speed. If the operation is intermittent, or if the designated speed is slow, the lubrication time can be lengthened in proportion.
* Depending on the robot operation state, the lubrication time will fluctuate, so determine the time according to the state so that the grease does not run out.
* The numbers in the above table correspond to the supply positions in Fig. 5-10.

(2) Lubrication method of J1, J2 axis reduction gears

1) Set the robot to the posture shown in Fig. 5-10. Take care not to put the ball screw spline axis near the grease lubrication port at this time.
2) Remove the embedded plug shown in Fig. 5-10.
3) Remove the air bleed bolt.
4) Insert the grease shown in Table 5-4 using a grease gun from the lubrication grease nipple.
5) Install the air bleed bolt.
6) Install the embedded plugs using the procedure in reverse.

[Note]Check the timing belt of 6-month inspection items together. At this time, confirm the grease doesn't leak out. Please lubricate a regulated amount of grease. if the amount of the grease lubricating is too much, grease might leak. Please confirm the amount of discharge of a grease gun beforehand. Wipe it out beautifully when the grease leak out and it sticks to the timing belt, and so on.

(3) Lubrication method of ball screw spline(RP-1AH/3AH/5AH)

1) Release the brake of J3 axis, and move up until the lower stopper of the ball screw spline interferes in the cover Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for the method of releasing the brake.
2) Turn off the controller's power supply and wipe the old grease on the exposed ball screw spline, and then paint the grease shown in the Table 5-3.
3) Turn on the controller's power supply and release the brake of J3 axis, and move down until the upper stopper of the ball screw spline interferes in the cover, and let applied grease get used. Wipe out the grease left after it got used.
4) Turn off the controller's power supply and wipe the old grease on the exposed ball screw spline, and then paint the grease shown in the Table 5-3.
5) Turn on the controller's power supply and release the brake of J3 axis, and move up until the lower stopper of the ball screw spline interferes in the cover, and let applied grease get used. Wipe out the grease left after it got used.

(4) Lubrication method of ball screw spline(RP-1AHC-SB/3AHC-SB/5AHC-SB)

1) Release the brake of J3 axis, and move up until the lower stopper of the ball screw spline interferes in the cover.
Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for the method of releasing the brake.
2) Turn off the controller's power supply and wipe the old grease on the exposed ball screw spline, and then paint the grease shown in the Table 5-3 with floating an upper cover as shown in Fig. 5-11.
3) Fix the cover as before, turn on the controller's power supply, release the brake of the J3 axis, and let applied grease get used. Wipe out the grease left after it got used.
4) Release the brake of the J3 axis, and move down until upper stopper of the ball screw spline interferes in the cover.
5) Turn off the controller's power supply and wipe the old grease on the exposed ball screw spline, and then paint the grease shown in the Table 5-3 with floating an lower cover as shown in Fig. 5-11.
6) Fix the cover as before, turn on controller's power supply, release the brake of the J3 axis, and let applied grease get used. Wipe out the grease left after it got used.
7) The cover is fixed as before.

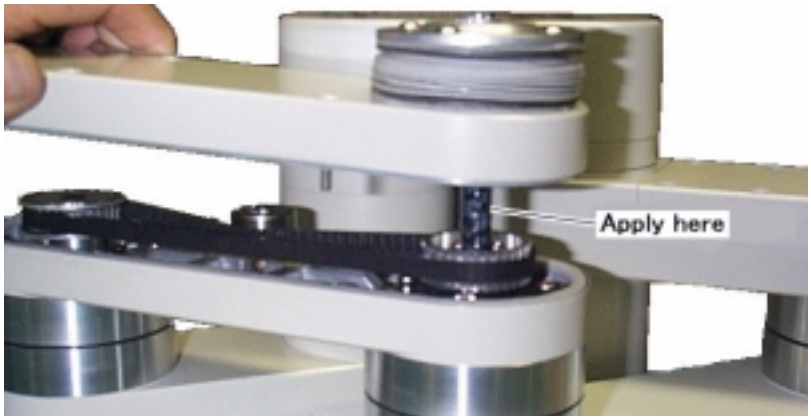


Fig.5-11 : Lubrication of the ball screw spline(RP-1AHC-SB/3AHC-SB/5AHC-SB)

5.3.5 Replacing the backup battery

An absolute encoder is used for the position detector, so the position must be saved with the backup battery when the power is turned OFF. The controller also uses a backup battery to save the program, etc. These batteries are installed when the robot is shipped from the factory, but as these are consumable parts, they must be replaced periodically by the user.

The guideline for replacing the battery is one year, but this will differ according to the robot's usage state. When the battery life nears, the "Battery cumulative time over alarm (Alarm No. 7520)" will occur. Once the alarm occurs, replace all batteries in the robot arm and controller as soon as possible. Lithium batteries (type: A6BAT and ER6) are used in both the controller and robot arm. The battery replacement procedures are as follow.

(1) Replacing the robot arm battery

⚠ CAUTION

Don't disconnect connector, etc. While replacing the battery, the encoder position data is saved by the power supplied from the controller. Thus, if the cable connection is incomplete, the encoder position data will be lost when the controller power is turned OFF. Several batteries are used in the robot arm, but replace all old batteries with new batteries at the same time.

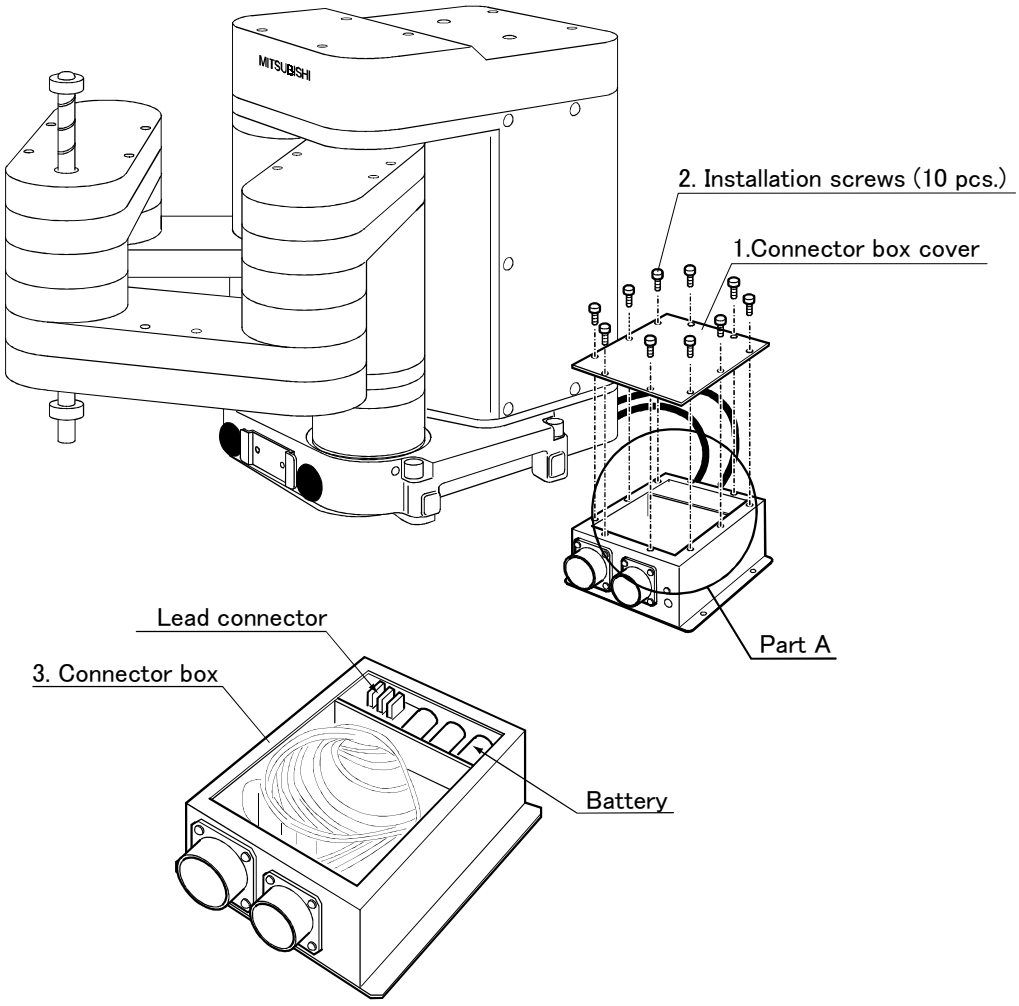


Fig.5-12 : Replacing the battery

1) Check that the cable between the robot unit's connector box and controller is securely connected.
2) Turn the controller power ON.
   While replacing the battery, the position data is saved by the power supplied from the controller. Thus, if the cable connection is incomplete or if the controller power is OFF, the position data will be lost.
3) Press the emergency stop button to place the robot in the emergency stop state. This must be carried out for safety purposes.
4) Remove the installation screws 2 shown in Fig. 5-12, and remove the connector box cover 1.
5) There is a battery holder in the connector box 3. Remove the old battery from the holder, and disconnect the lead connector.
6) Insert the new battery into the holder, and connect the lead connector. Make sure to replace all batteries with new ones.
7) Install the connector box cover 1 with the above steps in reverse.
8) Initialize the battery consumption time.
   Always carry out this step after replacing the battery, and initialize the battery usage time. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

⚠ CAUTION The encoder position data will be lost if the battery does not function correctly due to a disconnected connector, etc. While replacing the battery, the encoder position data is saved by the power supplied from the controller. Thus, if the cable connection is incomplete, the encoder position data will be lost when the controller power is turned OFF.

5.4 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-4, and spare parts that may be required during repairs are shown in Table 5-5. Purchase these parts from the dealer when required. Some Mitsubishi-designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from the dealer.

Table 5-4 : Consumable part list

No.	Part name	Type	Q'ty	Usage place	Supplier
Type: Each type commonness					
1	Lithium battery	A6BAT	3	Connector box	Mitsubishi Electric
2	Grease	Harmonic grease 4 BN o.2	An needed	Reduction gears of J1, J2 axis	
3		Marutenpu PS No.2	An needed	Ball screw spline	

Table 5-5 : Spare parts list

No.	Part name	Type	Q'ty	Usage place	Supplier
Type: RP-1AH/1AHC-SB					
1	Timming belt	３２７－３ＧＴ－９	1	Shoulder cover	Mitsubishi Electric
2		３６３－３ＧＴ－９	1	Shoulder cover	
3		２４６－３ＧＴ－９	2	Base	
4		３１５－３ＧＴ－９	1	No.1 arm L	
5		２７０－３ＧＴ－９	1	No.1 arm R	
6		３９３－３ＧＴ－６	1	No.2 arm L	
7		３８２－２ＧＴ－４	1	No.2 arm R	
8	AC servo motor (In the case of serial No. less than "AB001001".)	ＢＵ１４９Ｃ７０７Ｇ６１	1	J1 axis	
9		ＢＵ１４９Ｃ７０７Ｇ６２	1	J2 axis	
10		ＢＵ１４９Ｃ７０７Ｇ６３	1	J3 axis	
11		ＢＵ１４９Ｃ７０７Ｇ６４	1	J4 axis	
12	AC servo motor (In the case of serial No. is "AB001001" or more.)	ＢＵ１４９Ｃ６６０Ｇ５１	1	J1 axis	
13		ＢＵ１４９Ｃ６６０Ｇ５２	1	J2 axis	
14		ＢＵ１４９Ｃ６６０Ｇ５３	1	J3 axis	
15		ＢＵ１４９Ｃ６６０Ｇ５４	1	J4 axis	
16	Reduction gears	ＢＵ１４６Ｃ９１１Ｈ０３	2	J1, J2 axis	
Type: RP-3AH/3AHC-SB					
1	Timming belt	４４４－３ＧＴ－９	2	Shoulder cover,No.1 arm L	Mitsubishi Electric
2		５１３－３ＧＴ－９	1	Shoulder cover	
3		３１８－３ＧＴ－１２	2	Base	
4		３７５－３ＧＴ－９	1	No.1 arm R	
5		５５８－３ＧＴ－９	1	No.2 arm L	
6		５４３－３ＧＴ－９	1	No.2 arm R	

No.	Part name	Type	Q'ty	Usage place	Supplier
7	AC servo motor (In the case of serial No. less than "AB002031".)	ＢＵ１４９Ｃ６７４Ｇ６１	1	J1 axis	Mitsubishi Electric
8		ＢＵ１４９Ｃ６７４Ｇ６２	1	J2 axis	
9		ＢＵ１４９Ｃ６７４Ｇ６３	1	J3 axis	
10		ＢＵ１４９Ｃ７０７Ｇ６４	1	J4 axis	
11	AC servo motor (In the case of serial No. is "AB002031" or more.)	ＢＵ１４９Ｃ６７４Ｇ５１	1	J1 axis	
12		ＢＵ１４９Ｃ６７４Ｇ５２	1	J2 axis	
13		ＢＵ１４９Ｃ６７４Ｇ５３	1	J3 axis	
14		ＢＵ１４９Ｃ６６０Ｇ５４	1	J4 axis	
15	Reduction gears	ＢＵ１４６Ｃ７８５Ｈ０１	2	J1, J2 axis	
Type: RP-5AH/5AHC-SB					
1	Timming belt	４４４－３ＧＴ－９	1	Shoulder cover	Mitsubishi Electric
2		５１３－３ＧＴ－９	1	Shoulder cover	
3		３１８－３ＧＴ－１２	2	Base	
4		５６１－３ＧＴ－９	1	No.1 arm L	
5		４９５－３ＧＴ－９	1	No.1 arm R	
6		６８１－３ＧＴ－９	1	No.2 arm L	
7		６６６－３ＧＴ－９	1	No.2 arm R	
8	AC servo motor (In the case of serial No. less than "AB002052".)	ＢＵ１４９Ｃ６７４Ｇ６１	1	J1 axis	
9		ＢＵ１４９Ｃ６７４Ｇ６２	1	J2 axis	
10		ＢＵ１４９Ｃ６７４Ｇ６３	1	J3 axis	
11		ＢＵ１４９Ｃ７０７Ｇ６４	1	J4 axis	
12	AC servo motor (In the case of serial No. is "AB002052" or more.)	ＢＵ１４９Ｃ６７４Ｇ５１	1	J1 axis	
13		ＢＵ１４９Ｃ６７４Ｇ５２	1	J2 axis	
14		ＢＵ１４９Ｃ６７４Ｇ５３	1	J3 axis	
15		ＢＵ１４９Ｃ６６０Ｇ５４	1	J4 axis	
16	Reduction gears	ＢＵ１４６Ｃ７８５Ｈ０１	2	J1, J2 axis	

5.5 Resetting the origin

The origin is set so that the robot can be used with a high accuracy. After purchasing the robot, always carry out this step before starting work. The origin must be reset if the combination of robot and controller being used is changed or if the motor is changed causing an encoder area.
The types of origin setting methods are shown in Table 5-6.

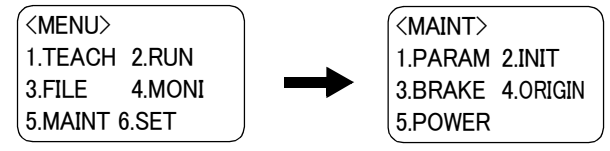
Table 5-6 : Origin setting method

No	Method	Explanation	Remarks
1	Origin data input method	The origin data set as the default is input from the T/B.	The setting method is explained in "2.3 Setting the origin" on page 12.
2	Jig method	The transportation jig is installed, and the transportation posture is set as the origin posture.	The setting method is explained in "5.5.1 Jig method" on page 55.
3	User origin method	A randomly designated position is set as the origin posture.	Before using this method, the origin must be set with the origin data input method (No. 1 above) or jig method (No. 2 above).The setting method is explained in "5.5.2 User origin method" on page 58.

5.5.1 Jig method

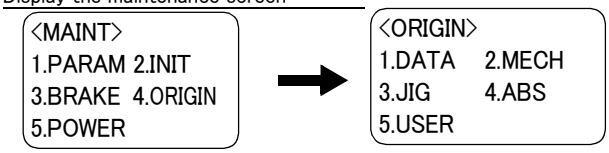
The method for setting the origin with the transportation jig is explained below.
This operation is carried out with the T/B. Set the [MODE] switch on the front of the controller to "TEACH", and set the T/B [ENABLE/DISABLE] switch to "ENABLE" to validate the T/B. Move the J4 axis to the upper end with jog operation beforehand.

The following operation is carried out while lightly pressing the T/B deadman switch.



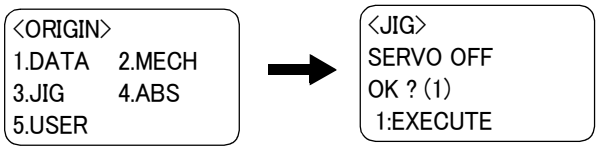
Display the maintenance screen: +C (J6) 5 STU

1) Press the [5] key on the menu screen, and display the maintenance screen.



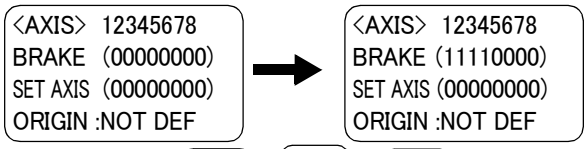
Display the method selection screen: -Y (J2) 4 MNO

2) Press the [4] key on the maintenance screen, and display the origin setting method selection screen.



Select the jig method: -Z (J3) 3 JKL → -B (J5) 1 DEF → INP EXE

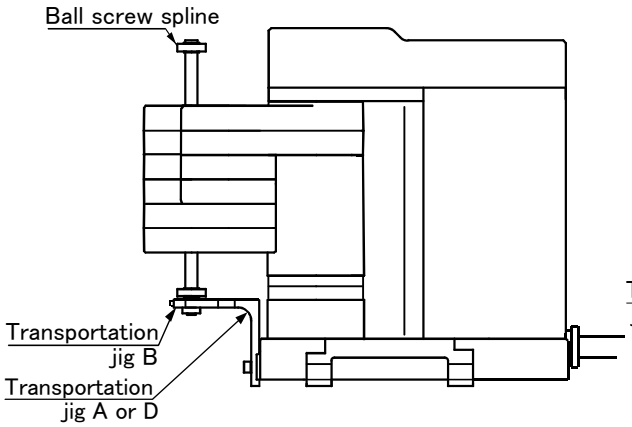
3) Press the [3] key and select the jig method. Then, press the [1] key and the [INP] key to turn the servo OFF.
Securely fix the transportation jig A to the base with the fixing bolts (M4 x 12, 2 bolts) in this state.



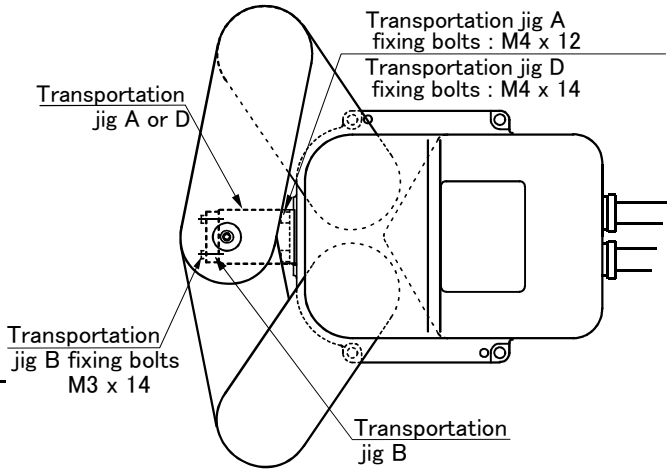
Release the brakes: -B (J5) 1 DEF → STEP MOVE + +X (J1) ' ;

4) As for a release of the brake, set "1" to the axis column of the "BRAKE" which the brakes are to be released, and press the [+X] key while holding down the [MOVE] key. The brake of specified axis will be released only while the [+X] key is pressed.

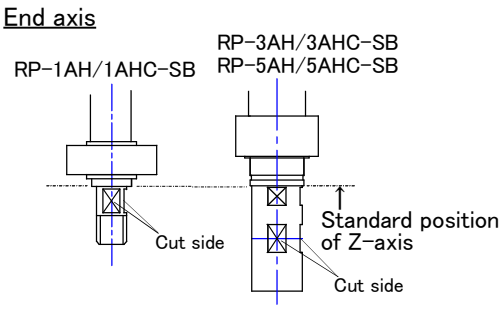
5) Origin posture of the robot arm is shown in the following.
The brake of each axis is released, and the end axis is fixed with the transportation jig.
The process is shown in the following.

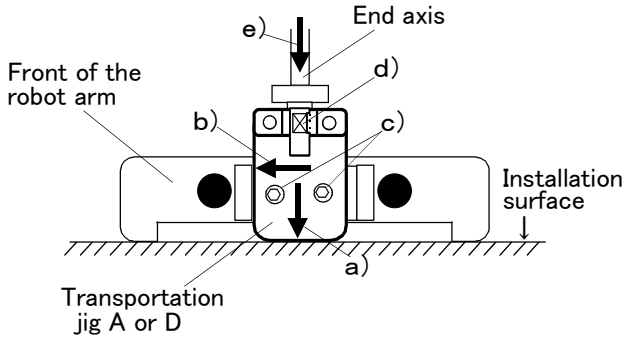


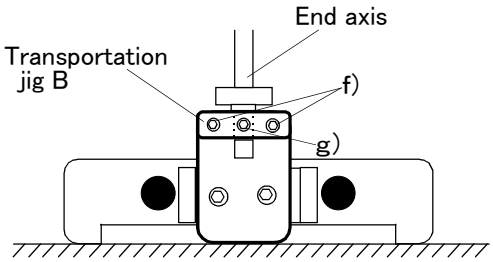
Side view


Transportation jig A fixing bolts : M4 x 12
Transportation jig D fixing bolts : M4 x 14
Transportation jig A or D
Transportation jig B fixing bolts M3 x 14
Transportation jig B

Top view







a)The transportation jig A (or, D) is pressed against to the installation surface.

b)The transportation jig A (or, D) is pressed against to the left side of the jig installation section on front of the robot arm as it is.

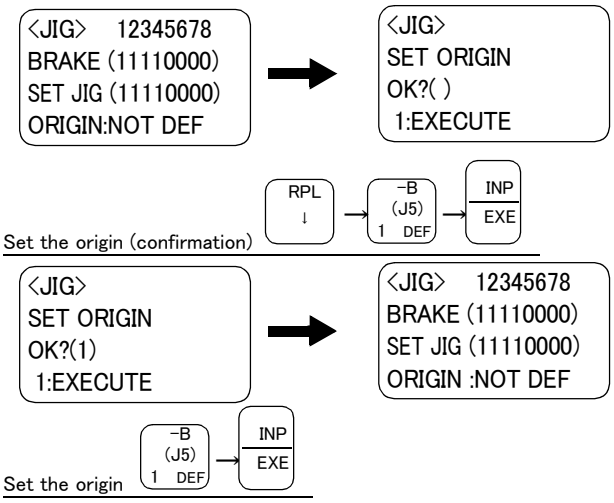
c)The transportation jig A (or, D) is fixed securely with the fixing bolts under this condition.

d)Release the brakes of all axis, and take the end axis of the robot to the V-cut position of the transportation jig A(or, D).

e)As it is, lower an end axis until the standard position of Z-axis hits a transportation jig A (or, D).

f)Install the transportation jig B. Tighten the fixing bolts gradually with releasing of brake.

g)Tighten the central screw of the transportation jig B with releasing of brake.



6) After setting the robot to the origin posture, press the [↓] key and input "1" for the axis for which the origin is to be set. Press the [INP] key, and the confirmation screen will appear.

7) Press the [1] key and then the [INP] key. The origin will be set.

This completes the setting of the origin with the jig method.

5.5.2 User origin method

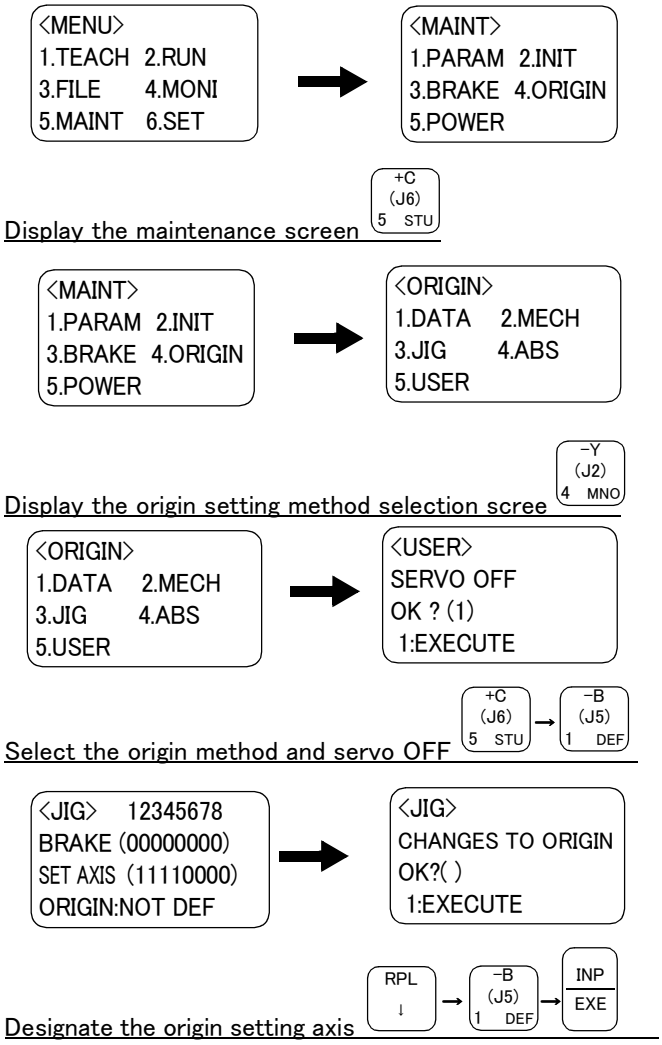
The procedure for setting the origin with the user origin method is explained below.
This operation is carried out with the teaching pendant. Set the [MODE] switch on the front of the controller to "TEACH", and set the [ENABLE/DISABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
The operation method is shown below.

When setting the origin for the first time using this method, carry out the operations in order from step 1). For the second and following time, move the robot arm to the user origin position with jog operation, and accurately position all axes. Then start the procedure from step 4).

1) Determine the user origin position
   Move the robot to the position to be set as the origin with jog operation. Refer to "2.4 Confirming the operation" on page 18 for details on the jog operation.

[Caution] This position is left as a guideline to position all axes with jog operation when setting the origin again with this method.

2) Enter the JOINT jog mode, and display the joint coordinates on the teaching pendant screen. Record the value of the axis for which the origin is to be set.
3) Input the value recorded in the "user designated origin parameter (USRORG)".
   The parameter details and input methods are described in the separate "Instruction Manual/Detailed Explanation of Functions and Operations". Refer to that manual and input the user designated origin position.

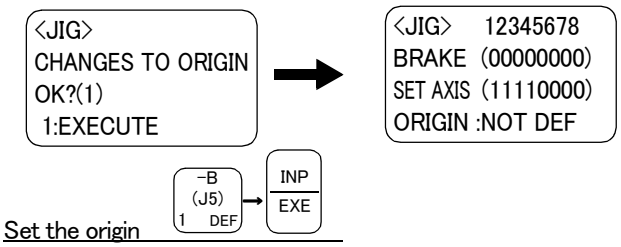


4) Next, set the origin.
   Press the [MENU] key to display the Menu screen.
5) Press the [5] key to display the Maintenance screen.

6) Press the [4] key to select the Origin Setting screen.

7) Press the [5] key to select the user origin method.
   Then, press [1] key and [INP] key to turn OFF the servo.

8) Press the [(] key, and input "1" for the axis for which the origin is to be set. Press the [INP] key to display the Confirmation screen.



9) Press the [1] key and then the [INP] key. The origin will be set.

This completes the setting of the origin with the user origin method.

5.5.3 Recording the origin data

When the origin has been set with the jig method, record that origin data on the origin data label. With this, the origin can be set with the origin data input method the next time.

Confirm the origin data on the teaching pendant screen (origin data input screen). The origin data label is enclosed with the arm or attached on the back of the connector box cover.
The teaching pendant operation method and connector box cover removal method for confirming the origin data is the same as the methods for setting the origin with the origin data input method. Refer to "2.3.2 Setting the origin with the origin data input method" on page 13, and write the origin data displayed on the teaching pendant onto the origin label.

1) Confirming the origin data label
   Remove the connector box cover.
   Refer to "5.3.5 Replacing the backup battery" on page 51, and remove the connector box cover.
2) Confirming the origin data
   Confirm the value displayed on the teaching pendant's Origin Data Input screen.
   Refer to "(5) Inputting the origin data" on page 16, and display the Origin Data Input screen on the teaching pendant display screen.
3) Recording the origin data
   Write the origin data displayed on the teaching pendant to the origin data label attached to the back of the connector box cover. Refer to "Fig. 2-6 Connecting the machine cables(CR1 controller)" on page 11, and "Fig. 2-7 Installing the T/B (control power OFF)" on page 12 for details on the origin data label.
4) Installing the connector box cover
   Install the connector box cover removed in step "1) Confirming the origin data label Remove the connector box cover. Refer to "5.3.5 Replacing the backup battery" on page 51, and remove the connector box cover." above.
   Refer to "5.3.5 Replacing the backup battery" on page 51, and replace the connector box cover.

This completes the recording of the origin data.

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